

## ANALYTICAL REPORT

Job Number: 160-18521-2

SDG Number: Headworks/9720-8

Job Description: ORNL Y-12 Outfall 200 Characterization

For:  
Alliant Corporation  
320 N Cedar Bluff Road  
Suite 200  
Knoxville, TN 37923  
Attention: Doug Milloway



Approved for release.  
Erika K Gish  
Project Manager II  
9/16/2016 3:46 PM

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09/16/2016

The test results in this report meet NELAP requirements for parameters for which accreditation is required or available. Any exceptions to the NELAP requirements are noted. Results pertain only to samples listed in this report. Pursuant to NELAP, this report shall not be reproduced, except in full, without the written approval of the laboratory. This report is confidential and is intended for the sole use of TestAmerica and its client. All questions regarding this report should be directed to the TestAmerica Project Manager.

Louisiana Lab Certification ID (Non-Potable, Solid/Haz. Material): 106151  
Florida Lab Certification ID (Drinking Water): E87689.

**TestAmerica Laboratories, Inc.**

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# Definitions/Glossary

Client: Alliant Corporation

Project/Site: ORNL Y-12 Outfall 200 Characterization

TestAmerica Job ID: 160-18521-2

SDG: Headworks/9720-8

## Qualifiers

### Metals

Qualifier	Qualifier Description
B	Compound was found in the blank and sample.
J	Estimated: The analyte was positively identified; the quantitation is an estimation
U	Undetected at the Limit of Detection.

### Rad

Qualifier	Qualifier Description
S	Tracer is outside acceptance limits.

## Glossary

**Abbreviation** These commonly used abbreviations may or may not be present in this report.

□	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

## CASE NARRATIVE

**Client: Alliant Corporation**

**Project: ORNL Y-12 Outfall 200 Characterization**

**Report Number: 160-18521-2**

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica St. Louis attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results for Chemistry analyses are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header. All soil/sediment sample results for radiochemistry analyses are based upon sample as dried and disaggregated with the exception of tritium, carbon-14, and iodine-129 by gamma spectroscopy unless requested as wet weight by the client."

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

### **RECEIPT**

The samples were received on 8/6/2016 8:30 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 0.7° C.

### **TCLP MERCURY**

Samples YMTFA74SE001 (160-18521-1) and YMTFA75SE001 (160-18521-2) were analyzed for TCLP mercury in accordance with EPA SW-846 Methods 1311/7470A. The samples were leached on 08/30/2016, and prepared and analyzed on 08/31/2016.

Mercury was detected in method blank LB 160-267256/1-B at a level that was above the method detection limit but below the reporting limit. The value should be considered an estimate, and has been flagged.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

### **RADIUM-226 BY ALPHA SPECTROMETRY**

Samples YMTFA74SE001 (160-18521-1) and YMTFA75SE001 (160-18521-2) were analyzed for Radium-226 by Alpha Spectrometry in accordance with ST-RC-0301. The samples were dried on 08/08/2016, prepared on 08/22/2016 and analyzed on 09/15/2016.

The At-217 tracer recovery for the following sample was low outside the QC limits of 30%: LCS 160-266021/2-A: 28.2%. The DOE/DOD Quality Systems Manual for Environmental Laboratories (QSM Rev. 5.0) allows for reporting results as quantitative when tracer recoveries are below 30% if a) the relative uncertainty associated with the tracer recovery is less than 10% (2 sigma), b) spectral resolution requirements are met and there are no indications of spectral interferences, and c) detection limit requirements are met. All three of these criteria are met for these samples: a) a minimum of 400 counts (which leads to 10% count uncertainty at 2 sigma) in the tracer peak, b) resolution of < 100 keV is met for all peaks, and c) the activity in the sample is well above the MDC. The data have been qualified and reported.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.



# Client Sample Results

Client: Alliant Corporation

Project/Site: ORNL Y-12 Outfall 200 Characterization

TestAmerica Job ID: 160-18521-2

SDG: Headworks/9720-8

## Client Sample ID: YMTFA74SE001

## Lab Sample ID: 160-18521-1

Matrix: Solid

Date Collected: 08/05/16 07:50

Date Received: 08/06/16 08:30

### Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.0022	B	0.0010	0.000079	mg/L	D	08/31/16 08:31	08/31/16 18:06	1

### Method: ST-RC-0301 - Radium-226 (Alpha Spectrometry)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			(2σ+/-)	(2σ+/-)						
Radium-226	0.712		0.187	0.196	1.00	0.190	pCi/g	08/22/16 18:53	09/15/16 10:19	1
Tracer	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
At-217	42.6		30 - 110					08/22/16 18:53	09/15/16 10:19	1

## Client Sample ID: YMTFA75SE001

## Lab Sample ID: 160-18521-2

Matrix: Solid

Date Collected: 08/05/16 09:25

Date Received: 08/06/16 08:30

### Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.000079	U	0.0010	0.000079	mg/L	D	08/31/16 08:31	08/31/16 18:14	1

### Method: ST-RC-0301 - Radium-226 (Alpha Spectrometry)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			(2σ+/-)	(2σ+/-)						
Radium-226	84.4		1.87	7.33	1.00	0.0791	pCi/g	08/22/16 18:53	09/15/16 10:19	1
Tracer	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
At-217	34.2		30 - 110					08/22/16 18:53	09/15/16 10:19	1

## Default Detection Limits

Client: Alliant Corporation

Project/Site: ORNL Y-12 Outfall 200 Characterization

TestAmerica Job ID: 160-18521-2

SDG: Headworks/9720-8

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**Method: 7470A - Mercury (CVAA) - TCLP**

**Prep: 7470A**

**Leach: 1311**

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Analyte	RL	MDL	Units	Method
Mercury	0.0010	0.000079	mg/L	7470A

# Tracer/Carrier Summary

Client: Alliant Corporation

Project/Site: ORNL Y-12 Outfall 200 Characterization

TestAmerica Job ID: 160-18521-2

SDG: Headworks/9720-8

## Method: ST-RC-0301 - Radium-226 (Alpha Spectrometry)

Matrix: Solid

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	(30-110)	Percent Yield (Acceptance Limits)					
			At-217					
160-18504-F-1-Q DU	Duplicate	50.0	-----	-----	-----	-----	-----	-----
160-18521-1	YMTFA74SE001	42.6	-----	-----	-----	-----	-----	-----
160-18521-2	YMTFA75SE001	34.2	-----	-----	-----	-----	-----	-----
LCS 160-266021/2-A	Lab Control Sample	28.2 S	-----	-----	-----	-----	-----	-----
MB 160-266021/1-A	Method Blank	36.5	-----	-----	-----	-----	-----	-----

### Tracer/Carrier Legend

At-217 = At-217

# QC Sample Results

Client: Alliant Corporation  
 Project/Site: ORNL Y-12 Outfall 200 Characterization

TestAmerica Job ID: 160-18521-2  
 SDG: Headworks/9720-8

## Method: 7470A - Mercury (CVAA)

**Lab Sample ID: LCS 160-267442/2-A**

**Matrix: Solid**

**Analysis Batch: 267626**

Analyte	Spike	LCS	LCS	Unit	D	%Rec.	Limits
	Added	Result	Qualifier				
Mercury	0.0250	0.0240		mg/L	96	80 - 120	

**Lab Sample ID: LB 160-267256/1-B**

**Matrix: Solid**

**Analysis Batch: 267626**

Analyte	LB	LB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Mercury	0.000110	J	0.0010	0.000079	mg/L	08/31/16	08:31	08/31/16 17:57	1

**Lab Sample ID: 160-18521-1 MS**

**Matrix: Solid**

**Analysis Batch: 267626**

Analyte	Sample	Sample	Spike	MS	MS	Unit	D	%Rec.	Limits
	Result	Qualifier	Added	Result	Qualifier				
Mercury	0.0022	B	0.0250	0.0261		mg/L	95	70 - 130	

**Lab Sample ID: 160-18521-1 MSD**

**Matrix: Solid**

**Analysis Batch: 267626**

Analyte	Sample	Sample	Spike	MSD	MSD	Unit	D	%Rec.	Limits	RPD	Limit
	Result	Qualifier	Added	Result	Qualifier						
Mercury	0.0022	B	0.0250	0.0263		mg/L	96	70 - 130		1	20

## Method: ST-RC-0301 - Radium-226 (Alpha Spectrometry)

**Lab Sample ID: MB 160-266021/1-A**

**Matrix: Solid**

**Analysis Batch: 270177**

Analyte	MB	MB	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
	Result	Qualifier	Uncert.	(2σ+/-)						
Radium-226	0.1953		0.0942	0.0956	1.00	0.0787	pCi/g	08/22/16 18:53	09/15/16 10:20	1

**Tracer**

Tracer	MB	MB	Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
At-217	36.5				30 - 110	08/22/16 18:53	09/15/16 10:20	1

**Lab Sample ID: LCS 160-266021/2-A**

**Matrix: Solid**

**Analysis Batch: 270178**

Analyte	Spike	LCS	LCS	Total	RL	MDC	Unit	%Rec.	Limits
	Added	Result	Qual	Uncert.					
Radium-226	12.1	14.07		1.47	1.00	0.103	pCi/g	117	70 - 130

**Tracer**

Tracer	LCS	LCS	Yield	Qualifier	Limits
At-217	28.2	S			30 - 110

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total/NA**  
**Prep Batch: 266021**

# QC Sample Results

Client: Alliant Corporation

Project/Site: ORNL Y-12 Outfall 200 Characterization

TestAmerica Job ID: 160-18521-2

SDG: Headworks/9720-8

## Method: ST-RC-0301 - Radium-226 (Alpha Spectrometry) (Continued)

Lab Sample ID: 160-18504-F-1-Q DU

Matrix: Solid

Analysis Batch: 270180

Client Sample ID: Duplicate

Prep Type: Total/NA

Prep Batch: 266021

Analyte	Sample	Sample	DU		DU		Total		RL	MDC	Unit	RER	Limit
	Result	Qual	Result	Qual	Uncert.	(2σ+/-)							
Radium-226	0.772		0.6592		0.171		1.00	0.152	pCi/g			0.31	1
<i>DU DU</i>													
Tracer	%Yield	Qualifier	Limits										
At-217	50.0		30 - 110										

# QC Association Summary

Client: Alliant Corporation

Project/Site: ORNL Y-12 Outfall 200 Characterization

TestAmerica Job ID: 160-18521-2

SDG: Headworks/9720-8

## Metals

### Leach Batch: 267256

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-18521-1	YMTFA74SE001	TCLP	Solid	1311	
160-18521-2	YMTFA75SE001	TCLP	Solid	1311	
LB 160-267256/1-B	Method Blank	TCLP	Solid	1311	
160-18521-1 MS	YMTFA74SE001	TCLP	Solid	1311	
160-18521-1 MSD	YMTFA74SE001	TCLP	Solid	1311	

### Prep Batch: 267442

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-18521-1	YMTFA74SE001	TCLP	Solid	7470A	267256
160-18521-2	YMTFA75SE001	TCLP	Solid	7470A	267256
LB 160-267256/1-B	Method Blank	TCLP	Solid	7470A	267256
LCS 160-267442/2-A	Lab Control Sample	Total/NA	Solid	7470A	
160-18521-1 MS	YMTFA74SE001	TCLP	Solid	7470A	267256
160-18521-1 MSD	YMTFA74SE001	TCLP	Solid	7470A	267256

### Analysis Batch: 267626

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-18521-1	YMTFA74SE001	TCLP	Solid	7470A	267442
160-18521-2	YMTFA75SE001	TCLP	Solid	7470A	267442
LB 160-267256/1-B	Method Blank	TCLP	Solid	7470A	267442
LCS 160-267442/2-A	Lab Control Sample	Total/NA	Solid	7470A	267442
160-18521-1 MS	YMTFA74SE001	TCLP	Solid	7470A	267442
160-18521-1 MSD	YMTFA74SE001	TCLP	Solid	7470A	267442

## Rad

### Leach Batch: 263822

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-18521-1	YMTFA74SE001	Total/NA	Solid	Dry and Grind	
160-18521-2	YMTFA75SE001	Total/NA	Solid	Dry and Grind	

### Leach Batch: 263919

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-18504-F-1-Q DU	Duplicate	Total/NA	Solid	Dry and Grind	

### Prep Batch: 266021

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-18521-1	YMTFA74SE001	Total/NA	Solid	DPS-0	263822
160-18521-2	YMTFA75SE001	Total/NA	Solid	DPS-0	263822
MB 160-266021/1-A	Method Blank	Total/NA	Solid	DPS-0	
LCS 160-266021/2-A	Lab Control Sample	Total/NA	Solid	DPS-0	
160-18504-F-1-Q DU	Duplicate	Total/NA	Solid	DPS-0	263919

TestAmerica St. Louis

# Lab Chronicle

Client: Alliant Corporation

Project/Site: ORNL Y-12 Outfall 200 Characterization

TestAmerica Job ID: 160-18521-2

SDG: Headworks/9720-8

**Client Sample ID: YMTFA74SE001**

**Date Collected: 08/05/16 07:50**

**Date Received: 08/06/16 08:30**

**Lab Sample ID: 160-18521-1**

**Matrix: Solid**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
TCLP	Leach	1311			267256	08/30/16 09:55	JWM	TAL SL
TCLP	Prep	7470A			267442	08/31/16 08:31	DAS	TAL SL
TCLP	Analysis	7470A		1	267626	08/31/16 18:06	DAS	TAL SL
Total/NA	Leach	Dry and Grind			263822	08/08/16 09:07	DRO	TAL SL
Total/NA	Prep	DPS-0			266021	08/22/16 18:53	CMC	TAL SL
Total/NA	Analysis	ST-RC-0301		1	270184	09/15/16 10:19	RTM	TAL SL

**Client Sample ID: YMTFA75SE001**

**Date Collected: 08/05/16 09:25**

**Date Received: 08/06/16 08:30**

**Lab Sample ID: 160-18521-2**

**Matrix: Solid**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
TCLP	Leach	1311			267256	08/30/16 09:55	JWM	TAL SL
TCLP	Prep	7470A			267442	08/31/16 08:31	DAS	TAL SL
TCLP	Analysis	7470A		1	267626	08/31/16 18:14	DAS	TAL SL
Total/NA	Leach	Dry and Grind			263822	08/08/16 09:07	DRO	TAL SL
Total/NA	Prep	DPS-0			266021	08/22/16 18:53	CMC	TAL SL
Total/NA	Analysis	ST-RC-0301		1	270185	09/15/16 10:19	RTM	TAL SL

**Laboratory References:**

TAL SL = TestAmerica St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

# Certification Summary

Client: Alliant Corporation

Project/Site: ORNL Y-12 Outfall 200 Characterization

TestAmerica Job ID: 160-18521-2

SDG: Headworks/9720-8

## Laboratory: TestAmerica St. Louis

Unless otherwise noted, all analytes for this laboratory were covered under each certification below.

Authority	Program	EPA Region	Certification ID	Expiration Date
Louisiana	NELAP	6	04080	06-30-17

The following analytes are included in this report, but certification is not offered by the governing authority:

Analysis Method	Prep Method	Matrix	Analyte
7470A	7470A	Solid	Mercury
ST-RC-0301	DPS-0	Solid	Radium-226

# Method Summary

Client: Alliant Corporation

Project/Site: ORNL Y-12 Outfall 200 Characterization

TestAmerica Job ID: 160-18521-2

SDG: Headworks/9720-8

Method	Method Description	Protocol	Laboratory
7470A	Mercury (CVAA)	SW846	TAL SL
ST-RC-0301	Radium-226 (Alpha Spectrometry)	TAL-STL	TAL SL

**Protocol References:**

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

TAL-STL = TestAmerica Laboratories, St. Louis, Facility Standard Operating Procedure.

**Laboratory References:**

TAL SL = TestAmerica St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

## Sample Summary

Client: Alliant Corporation

Project/Site: ORNL Y-12 Outfall 200 Characterization

TestAmerica Job ID: 160-18521-2

SDG: Headworks/9720-8

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-18521-1	YMTFA74SE001	Solid	08/05/16 07:50	08/06/16 08:30
160-18521-2	YMTFA75SE001	Solid	08/05/16 09:25	08/06/16 08:30

## REAGENT TRACEABILITY SUMMARY

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Reagent ID	Exp Date	Prep Date	Dilutant Used	Reagent Final Volume	Parent Reagent		Analyte	Concentration
					Reagent ID	Volume Added		
82232-334_00001	06/03/60		Eckert & Ziegler, Lot 82232-334		(Purchased Reagent)	Am-241 Pu-239 Th-230		7.281 Bq 7.137 Bq 7.63 Bq
82233-334_00001	06/03/60		Eckert & Ziegler, Lot 82233-334		(Purchased Reagent)	Am-241 Pu-239 Th-230		5.114 Bq 6.064 Bq 4.95 Bq
82235-334_00001	06/04/60		Eckert & Ziegler, Lot 82235-334		(Purchased Reagent)	Am-241 Pu-239 Th-230		7.466 Bq 6.897 Bq 7.167 Bq
82236-334_00001	06/02/60		Eckert & Ziegler, Lot 82236-334		(Purchased Reagent)	Am-241 Pu-239 Th-230		6.891 Bq 6.664 Bq 7.107 Bq
82237-334_00003	06/01/60		Eckert & Ziegler, Lot 82237-334		(Purchased Reagent)	Am-241 Pu-239 Th-230		5.608 Bq 6.424 Bq 5.856 Bq
82242-334_00001	06/08/60		Eckert & Ziegler, Lot 82242-334		(Purchased Reagent)	Am-241 Pu-239 Th-230		7.145 Bq 6.414 Bq 6.583 Bq
82246-334_00001	06/09/60		Eckert & Ziegler, Lot 82246-334		(Purchased Reagent)	Am-241 Pu-239 Th-230		6.002 Bq 5.353 Bq 5.57 Bq
82247-334_00001	06/10/60		Eckert & Ziegler, Lot 82247-334		(Purchased Reagent)	Am-241 Pu-239 Th-230		6.291 Bq 5.746 Bq 6.251 Bq
Hg Curve Int._00756	09/01/16	08/31/16	2% Nitric Acid, Lot 954989	100 mL	HG CAL_00009	0.1 mL	Mercury	0.1 ug/mL
.HG CAL 00009	07/26/17		Spex, Lot 21-44HGY		(Purchased Reagent)		Mercury	100 ug/mL
Hg QC Int._00736	09/01/16	08/31/16	2% Nitric Acid, Lot 954989	100 mL	HG QC_00007	0.1 mL	Mercury	0.1 ug/mL
.HG QC_00007	07/26/17		Inorganic Ventures, Lot J2-HG02139		(Purchased Reagent)		Mercury	100 ug/mL
NRM-4_00001	11/01/38		US DOE, Lot Set Number 45		(Purchased Reagent)	Pb-210 Ra-228 Radium-226 Th-230 Th-232 Total Alpha Emitting Radium Isotopes U-234 U-238		9.3 pCi/g 9.5 pCi/g 12.2 pCi/g 13.5 pCi/g 9.5 pCi/g 12.2 pCi/g 11.4 pCi/g 11.9 pCi/g
TCLP HG SPK_00057	09/02/16	08/11/16	2% Nitric Acid, Lot NA	100 mL	HG CAL_00009	3 mL	Mercury	3 ug/mL
.HG CAL 00009	07/26/17		Spex, Lot 21-44HGY		(Purchased Reagent)		Mercury	100 ug/mL
Th-229_00021	08/01/17	07/20/16	0.1M HNO3, Lot n/a	500 mL	Th-229_00017	15 mL	At-217	67.2296 dpm/mL

## REAGENT TRACEABILITY SUMMARY

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Reagent ID	Exp Date	Prep Date	Dilutant Used	Reagent Final Volume	Parent Reagent		Analyte	Concentration			
					Reagent ID	Volume Added					
.Th-229_00017	08/01/17	08/20/14	0.1M HNO3, Lot n/a	100 mL	Th-229_00016	5.0464 g	Th-229	67.2296 dpm/mL			
							At-217	2240.99 dpm/mL			
..Th-229_00016		08/06/64	Analytics, Lot 97790		(Purchased Reagent)		Th-229	2240.99 dpm/mL			
					At-217			740.127 Bq/g			
					Th-229			740.127 Bq/g			

Reagent

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**82232-334  00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82232-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

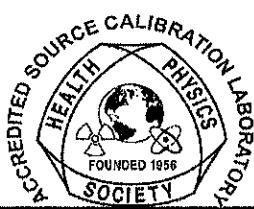
This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 3-Jun-2010      **12:00 PM EST**

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				u <sub>A</sub>	u <sub>B</sub>	U
Th-230	7.630E+00	4420-4800	7.540E+04	0.7	1.1	2.6
Pu-239	7.137E+00	4950-5240	2.410E+04	0.7	1.1	2.6
Am-241	7.281E+00	5280-5600	4.326E+02	0.7	1.1	2.6
Total Activity	2.210E+01	3000-8000		0.4	1.1	2.3

\*Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)



**Comments:**

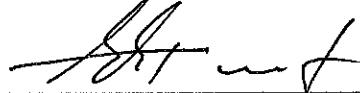
Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

CAUTION: Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:

  
A. Chen, Spectroscopist

QA Approved:

  
E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010



Reagent

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**82233-334  00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82233-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

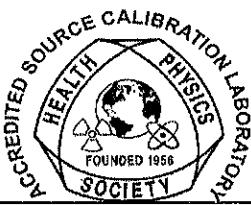
This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 3-Jun-2010      12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				$u_A$	$u_B$	U
Th-230	4.950E+00	4420-4800	7.540E+04	0.8	1.1	2.7
Pu-239	6.064E+00	4950-5240	2.410E+04	0.7	1.1	2.6
Am-241	5.114E+00	5280-5600	4.326E+02	0.8	1.1	2.7
Total Activity	1.616E+01	3000-8000		0.1	1.1	2.2

\***Uncertainty:** U - Relative expanded uncertainty,  $k = 2$ . See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)



**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

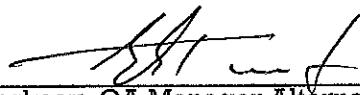
**CAUTION:** Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:



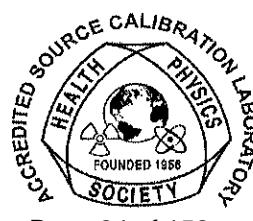
A. Chen, Spectroscopist

QA Approved:



E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010



Reagent

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**82235-334  00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82235-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

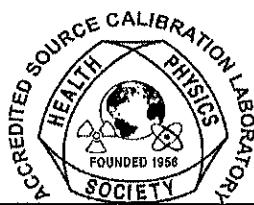
This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 4-Jun-2010 12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				u <sub>A</sub>	u <sub>B</sub>	U
Th-230	7.167E+00	4420-4800	7.540E+04	0.8	1.1	2.7
Pu-239	6.897E+00	4950-5240	2.410E+04	0.8	1.1	2.7
Am-241	7.466E+00	5280-5600	4.326E+02	0.8	1.1	2.7
Total Activity	2.161E+01	3000-8000		0.5	1.1	2.4

\*Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)



**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

CAUTION: Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:

  
A. Chen, Spectroscopist

QA Approved:

  
E. A. Taskaev, QA Manager Alternate

Date: 06.24.2010



Reagent

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**82236-334  00001**

## CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

82236-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

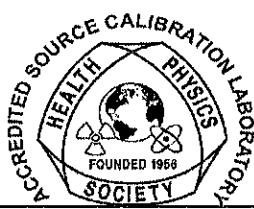
This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 2-Jun-2010 12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				u <sub>A</sub>	u <sub>B</sub>	U
Th-230	7.107E+00	4420-4800	7.540E+04	0.7	1.1	2.6
Pu-239	6.664E+00	4950-5240	2.410E+04	0.8	1.1	2.7
Am-241	6.891E+00	5280-5600	4.326E+02	0.7	1.1	2.6
Total Activity	2.071E+01	3000-8000		0.4	1.1	2.3

\***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)



**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

CAUTION: Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by: ZKCh  
A. Chen, Spectroscopist

QA Approved: EAT  
E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010



Reagent

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**82237-334  00003**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82237-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

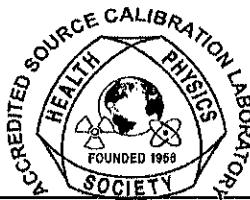
This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 1-Jun-2010      12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				u <sub>A</sub>	u <sub>B</sub>	U
Th-230	5.856E+00	4420-4800	7.540E+04	1.0	1.1	3.0
Pu-239	6.424E+00	4950-5240	2.410E+04	0.9	1.1	2.8
Am-241	5.608E+00	5280-5600	4.326E+02	1.0	1.1	3.0
Total Activity	1.793E+01	3000-8000		0.6	1.1	2.5

\*Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)



**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

**CAUTION:** Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

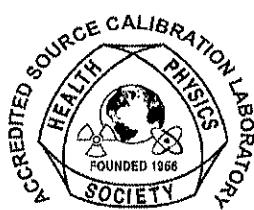
Source Calibrated by:

A. Chen  
A. Chen, Spectroscopist

QA Approved:

EAT  
E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010



Reagent

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**82242-334  00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82242-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 8-Jun-2010      12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				u <sub>A</sub>	u <sub>B</sub>	U
Th-230	6.583E+00	4420-4800	7.540E+04	0.9	1.1	2.8
Pu-239	6.414E+00	4950-5240	2.410E+04	0.9	1.1	2.8
Am-241	7.145E+00	5280-5600	4.326E+02	0.9	1.1	2.8
Total Activity	2.018E+01	3000-8000		0.6	1.1	2.5

\*Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)



**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

**CAUTION:** Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:

A. Chen  
A. Chen, Spectroscopist

QA Approved:

E. A. Taskaev  
E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010



Reagent

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**82246-334  00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82246-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 9-Jun-2010      12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				u <sub>A</sub>	u <sub>B</sub>	U
Th-230	5.570E+00	4420-4800	7.540E+04	1.0	1.1	3.0
Pu-239	5.353E+00	4950-5240	2.410E+04	1.0	1.1	3.0
Am-241	6.002E+00	5280-5600	4.326E+02	1.0	1.1	3.0
Total Activity	1.696E+01	3000-8000		0.7	1.1	2.6

\*Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)

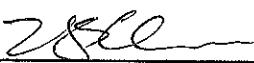


**Comments:**

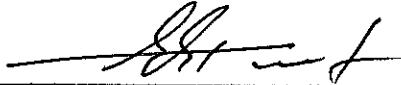
Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

**CAUTION:** Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:

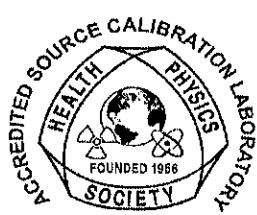
  
A. Chen, Spectroscopist

QA Approved:

  
E. A. Taskaev, QA Manager Alternate

Date:

06.24.2010



Reagent

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**82247-334  00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82247-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

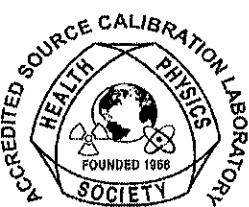
This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 10-Jun-2010 12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				u <sub>A</sub>	u <sub>B</sub>	U
Th-230	6.251E+00	4420-4800	7.540E+04	0.9	1.1	2.8
Pu-239	5.746E+00	4950-5240	2.410E+04	0.9	1.1	2.8
Am-241	6.291E+00	5280-5600	4.326E+02	0.9	1.1	2.8
Total Activity	1.832E+01	3000-8000		0.6	1.1	2.5

\*Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)



**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

CAUTION: Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

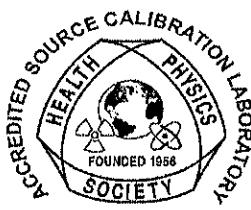
Source Calibrated by:

A. Chen  
A. Chen, Spectroscopist

QA Approved:

E. A. Taskaev  
E. A. Taskaev, QA Manager Alternate

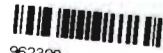
Date: 06-24-2010



Reagent

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**HG CAL\_00009**



962390

ID: HG CAL\_00009  
 Exp. 07/26/17 PPD DAS Open 07/26/16  
 Hg CAL 100PPM



Reference Materials Producer  
 Cert #2495.01



Chemical Testing  
 Cert #2495.02

# SPEXertificate®

## Certificate of Reference Material

**Catalog Number:** PLHG2-1Y

**Lot No.** 21-44HGY

**Description:** 100 µg/mL Mercury

**Matrix:** 5% HNO<sub>3</sub>

This ASSURANCE® Certified Reference Material, CRM, is intended primarily for use as a calibration standard or quality control standard for inorganic spectroscopic instrumentation such as ICP-OES, DCP, AA, ICP-MS, and XRF. It can be employed in USEPA, ASTM and other methods relevant to the certified properties listed below.

**Certified Value:** 100 µg/mL ±0.5 µg/mL

**Certified Value is Traceable to:** 3133\*

\* - indicates NIST SRM

† - indicates SPEX CertiPrep CRM (when NIST SRM is not available)

The CRM is prepared gravimetrically using high purity Mercury Metal, Lot# 06121D. The certified value listed is the average of values obtained by classical wet assay and ICP spectrometer analysis.

Refer to side 2 for details of measurement uncertainties.

**Classical Wet Assay:** 100 µg/mL

**Method:** This value was derived from dilution calculations of a Titrimetry analysis result of a Mercury concentrate. The concentrate was analyzed by EDTA titration using Ammonium Thiocyanate with Ferric Nitrate as indicator.

**Instrumental Analysis by ICP Spectrometer:** 100 µg/mL

### Uncertified Properties

**Density:** 1.025 g/mL @ 20.0°C

### Trace Metallic Impurities in the Actual Solution via ICP-MS Analysis:

Element	µg/mL										
Ag	0.001	Cr	<0.001	Ho	<0.001	Nb	<0.001	Ru	<0.001	Th	<0.001
Al	<0.001	Cs	<0.001	In	<0.001	Nd	<0.001	Sb	<0.001	Ti	<0.001
As	<0.001	Cu	<0.001	Ir	<0.001	Ni	<0.001	Sc	<0.001	Tl	<0.001
Au	<0.1	Dy	<0.001	K	<0.08	P	<0.1	Se	<0.002	Tm	<0.001
B	<0.001	Er	<0.001	La	<0.001	Pb	<0.001	Si	<0.1	U	<0.001
Ba	<0.001	Eu	<0.001	Li	<0.001	Pd	<0.1	Sm	<0.001	V	<0.001
Be	<0.001	Fe	<0.001	Lu	<0.001	Pr	<0.001	Sn	<0.001	W	<0.001
Bi	<0.001	Ga	<0.001	Mg	<0.001	Pt	<0.001	Sr	<0.001	Y	<0.001
Ca	0.006	Gd	<0.001	Mn	<0.001	Rb	<0.001	Ta	<0.001	Yb	<0.001
Cd	<0.001	Ge	<0.001	Mo	<0.001	Re	<0.001	Tb	<0.001	Zn	<0.001
Ce	<0.001	Hf	<0.001	Na	0.005	Rh	<0.001	Te	<0.001	Zr	0.002
Co	<0.001										

Balances are calibrated regularly with weight sets traceable to NIST #32856, #32867 and others. This CRM is guaranteed stable and accurate to +/- 0.5% of the certified value. This includes uncertainty components due to preparation, homogeneity by the most precise method, and short-term and long-term stability. This guarantee is valid for a period of one year from the date of certification only when the material is unopened and stored under ambient laboratory conditions.

Date of Certification:

JUL - 2016

Certifying Officer:

# Report of Certification

This Certified Reference Material (CRM) has been prepared and certified under an ISO 9001:2008, ISO 17025:2005, and ISO Guide 34:2009 quality system consistent with the following guides:

- ISO 9001: Quality management systems – Requirements – certified by UL-DQS
- ISO 17025: General requirements for the competence of testing and calibration laboratories – accredited by A2LA
- ISO Guide 34: General requirements for the competence of reference material producers – accredited by A2LA
- ISO Guide 31: Reference Materials – Contents of certificates and labels
- ISO Guide 35: Reference Materials – General & Statistical Principles for Certification
- Guide To The Expression Of Uncertainty In Measurement 1997
- EURACHEM/CITAC Guide: Quantifying Uncertainty in Analytical Measurement – Second Edition
- ASTM Guide D6362-98
- NIST Technical Note 1297
- ILAC-G12-2000: Guidelines for the requirements for the competence of reference materials producers
- ISO/REMCO N280

## Material Source:

All analytes and matrix materials are obtained and verified by SPEX CertiPrep from pre-qualified vendors as per ISO 9001:2008, ISO 17025:2005, and ISO Guide 34:2009 guidelines. Vendor identifications are proprietary, however sources of all materials used in the preparation and testing of SPEX CertiPrep CRMs are tracked and documented. For further assistance, please contact the Sales Support Department at [crmsales@spexcsp.com](mailto:crmsales@spexcsp.com).

## Instructions for Use:

Primary usage of this CRM is in neat form or diluted serially with matrix of a purity at or greater than the purity of the original matrix solution. If dilution is required the diluent must be compatible with all certified analytes and contain stabilizers appropriate for the period of intended use. The CRM can also be used as a spike or with a spike, again with appropriate compatibility considerations. All solutions should be thoroughly mixed, by shaking, prior to use and never pipetted directly from the bottle. All surfaces that come in contact with the solution must be thoroughly cleaned and leached prior to use. Dilutions should be performed only with Class A volumetric glassware.

## Method of Preparation:

Clean laboratory procedures and techniques have been used throughout the preparation. All materials, equipment, analytical instrumentation and personnel have been qualified prior to use. The highest purity acids applicable, 18 megohm, double deionized water, acid-leached triple-rinsed bottles (where appropriate), and Class A/calibrated volumetrics have been used in all preparations.

## Homogeneity:

The homogeneity of the CRM has been confirmed by procedures consistent with ISO 17025:2005, ISO Guide 34:2009, and ASTM D6362-98 Appendix X2. Random, replicate samples of the final, packaged material have been analyzed to prove homogeneity in accordance with our internal procedure 4600-HOMOGEN-1A. Since the product is highly homogeneous, any sample size taken for analysis would be within the uncertainty budget. This is consistent with the intended use of the CRM.

## Statistical Estimator and Confidence Limits:

The certified value 'X' listed on the reverse of this document is at the 95% level of confidence and can be expressed as:

- $X = x \pm U$  where  $X$  = certified value,  $U$  = expanded uncertainty,  $x$  = property value
- $U = k u_c$  where  $k = 2$  is the coverage factor at the 95% confidence level
- $u_c$  is obtained by combining the individual element standard uncertainty components  $u_i$ , and  $u_c = \sqrt{\sum u_i^2}$

## Certification Traveler Report:

All certified values reported were derived from the Traveler Report (SPEX CertiPrep's traceability documentation) identified by the lot number of this CRM. During the stated period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution. For further assistance, please contact the Sales Support Department at [crmsales@spexcsp.com](mailto:crmsales@spexcsp.com).

## Legal Notice:

SPEX CertiPrep reference materials are not for any cosmetic, drug or household application and are to be used only by qualified individuals who are trained in appropriate procedures. No claims against SPEX CertiPrep, LLC of any kind whatsoever, whether based on breach of warranty, alleged negligence, or otherwise, with respect to this Reference Material shall be greater than the purchase price. In no event shall SPEX CertiPrep, LLC be liable for any loss of profits or any incidental, special, or consequential damages.



Reagent

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**HG QC\_00007**

## 1.0 ACCREDITATION / REGISTRATION

INORGANIC VENTURES is accredited to ISO Guide 34, "General Requirements for the Competence of Reference Material Producers" and ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories".

Inorganic Ventures is also an ISO 9001 registered manufacturer (SAI Global File Number 010105).



## 2.0 PRODUCT DESCRIPTION

Product Code: Single Analyte Mass Spec Solution



962391

Catalog Number: MSHGN-100PPM

 ID: HG QC\_00007  
 Exp 07/26/17 Prod DAS Opn 07/26/16  
 HG QC 100PPM

Lot Number: J2-HG02139

Matrix: 10% (v/v) HNO<sub>3</sub>

Value / Analyte(s): 100 µg/mL ea:

Hg

Starting Material: Hg Metal

Starting Material Lot#: R307HGA1, 1780

Starting Material Purity: 99.9987%

## 3.0 CERTIFIED VALUES AND UNCERTAINTIES

Certified Value: 99.93 ± 0.54 µg/mL

Certified Density: 1.048 g/mL (measured at 20 ± 1 °C)

### Assay Information:

ANALYTE	METHOD	NIST SRM#	SRM LOT#
Hg	ICP Assay	3133	061204
Hg	EDTA	928	928

The following equations are used in the calculation of the certified value and the uncertainty. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k = 2.

## Characterization of CRM by two independent methods

### Characterization of CRM/RM by Two Methods

Certified Value,  $X_{CRM/RM}$ , where two methods of characterization are used  
is the weighted mean of the two results:

$$X_{CRM/RM} = [(w_a)(X_a) + (w_b)(X_b)]$$

$X_a$  = mean of Assay Method A with standard uncertainty  $u_{char\ a}$

$X_b$  = mean of Assay Method B with standard uncertainty  $u_{char\ b}$

$w_a$  and  $w_b$  = the weighting factors for each method calculated using the inverse square of the variance:

$$w_a = (1/u_{char\ a})^2 / ((1/u_{char\ a})^2 + (1/u_{char\ b})^2)$$

$$w_b = (1/u_{char\ b})^2 / ((1/u_{char\ a})^2 + (1/u_{char\ b})^2)$$

$$CRM/RM Expanded Uncertainty ( $\pm$ ) =  $U_{CRM/RM} = k(u^2_{char\ a\&b} + u^2_{bb} + u^2_{lts} + u^2_{sts})^{1/2}$$$

$k$  = coverage factor = 2 in all cases at Inorganic Ventures

$u_{char\ a\&b} = [(w_a)^2(u_{char\ a})^2 + (w_b)^2(u_{char\ b})^2]^{1/2}$  where  $u_{char\ a}$  and  $u_{char\ b}$  are the square root of the sum of the squares of errors from characterization which include instrument measurement, density, NIST SRM uncertainty, weighing, and volume

$u_{bb}$  = bottle to bottle homogeneity standard uncertainty

$u_{lts}$  = long term stability standard uncertainty (storage)

$u_{sts}$  = short term stability standard uncertainty (transportation)

## Characterization of CRM by one method

### Characterization of CRM/RM by One Method

Certified Value,  $X_{CRM/RM}$ , where one method of characterization is used is the mean of individual results:

$$X_{CRM/RM} = \text{mean of Assay Method A with standard uncertainty } u_{char\ a}$$

$$CRM/RM Expanded Uncertainty ( $\pm$ ) = U_{CRM/RM} = k(u^2_{char\ a} + u^2_{bb} + u^2_{lts} + u^2_{sts})^{1/2}$$

$k$  = coverage factor = 2 in all cases at Inorganic Ventures

$u_{char\ a}$  = square root of the sum of the squares of the errors from characterization which include instrumental measurement, density, NIST SRM uncertainty, weighing, and volume

$u_{bb}$  = bottle to bottle homogeneity standard uncertainty

$u_{lts}$  = long term stability standard uncertainty (storage)

$u_{sts}$  = short term stability standard uncertainty (transportation)

## 4.0 TRACEABILITY TO NIST

- This product is traceable to NIST via an unbroken chain of comparisons. The uncertainties for each certified value are reported, taking into account the SRM/RM uncertainty error and the measurement, weighing and volume dilution errors. In rare cases where no NIST SRM/RM are available, the term 'in-house std.' is specified.

### 4.1 Thermometer Calibration

- All thermometers are NIST traceable through thermometers that are calibrated by an accredited calibration laboratory.

### 4.2 Balance Calibration

- All analytical balances are calibrated by an accredited calibration laboratory and procedure. The weights used for testing are annually compared to master weights and are traceable to NIST.

### 4.3 Glassware Calibration

- An in-house procedure is used to calibrate all Class A glassware used in the manufacturing and quality control of CRM/RMs.

## 5.0 TRACE METALLIC IMPURITIES (TMI ) DETERMINED BY ICP-MS AND ICP-OES (µg/mL)

CRM/RMs are tested for trace metallic impurities by Axial ICP-OES and ICP-MS. The result from the most sensitive method for each element, is reported below. Solutions tested by ICP-MS were analyzed in an ULPA-Filtered Clean Room. An ULPA-Filter is 99.9985% efficient for the removal of particles down to 0.3 µm.

M	Ag	0.000024	M	Eu	<	0.000100	O	Na	0.000116	M	Se	<	0.002205	O	Zn	<	0.001349		
O	Al	0.000041	O	Fe	>	0.000031	M	Nb	<	0.000100	O	Si	<	0.010380	M	Zr	<	0.000200	
M	As	<	0.000802	M	Ga	<	0.000100	M	Nd	<	0.000100	M	Sm	<	0.000100				
O	Au	<	0.001038	M	Gd	<	0.000100	M	Ni	<	0.000702	M	Sn	<	0.000100				
M	B	<	0.004811	M	Ge	<	0.000301	M	Os	<	0.000100	O	Sr	<	0.000047				
M	Ba	<	0.000301	M	Hf	<	0.000100	O	P	<	0.010380	M	Ta	<	0.000100				
O	Be	<	0.000104	s	Hg	<		M	Pb	<	0.000100	M	Tb	<	0.000100				
M	Bi	<	0.001002	M	Ho	<	0.000100	M	Pd	<	0.000401	M	Te	<	0.000802				
O	Ca	0.000424	M	In	<	0.000100	M	Pr	<	0.000100	M	Th	<	0.000100					
M	Cd	<	0.000100	M	Ir	<	0.000100	M	Pt	<	0.000100	O	Ti	<	0.000208				
M	Ce	<	0.000100	O	K	0.000062	M	Rb	<	0.000401	O	Tl	<	0.005014					
M	Co	0.000015	M	La	<	0.000100	M	Re	<	0.000100	M	Tm	<	0.000100					
O	Cr	<	0.000603	O	Li	<	0.000039	M	Rh	<	0.000100	M	U	<	0.000100				
M	Cs	<	0.000100	O	Lu	<	0.000064	M	Ru	<	0.000100	M	V	<	0.000301				
O	Cu	<	0.000666	O	Mg	0.000139	O	S	0.000375	M	W	<	0.000100						
M	Dy	<	0.000100	O	Mn	0.000019	M	Sb	<	0.000401	M	Y	<	0.000100					
M	Er	<	0.000100	O	Mo	0.000072	O	Sc	<	0.000125	M	Yb	<	0.000100					

M - Checked by ICP-MS

O - Checked by ICP-OES

i - Spectral Interference

n - Not Checked For s - Solution Standard Element

## **6.0 INTENDED USE**

- For the calibration of analytical instruments and validation of analytical methods as appropriate.

## **7.0 INSTRUCTIONS FOR THE CORRECT USE OF THIS REFERENCE MATERIAL**

### **7.1 Storage and Handling Recommendations**

- Store between approximately 4° - 30° C while in sealed TCT bag.
- While stored in the sealed TCT bag, transpiration of this CRM/RM is negligible. After opening the sealed TCT bag transpiration of the CRM/RM will occur, resulting in a gradual increase in the analyte concentration(s). It is the responsibility of the user to account for this effect. When the bottle is weighed both before and after being placed in storage, the mass difference observed will be a measure of transpiration mass loss.
- After opening the sealed TCT bag keep cap tightly sealed when not in use. Store and use at 20° ± 4° C. Do not pipette from the container. Do not return removed aliquots to container.
- For more information, visit [www.inorganicventures.com/TCT](http://www.inorganicventures.com/TCT)

**Atomic Weight; Valence; Coordination Number; Chemical Form in Solution** - 200.59 +2 4 Hg(OH)(aq) 1+  
**Chemical Compatibility** - Stable in HNO<sub>3</sub>. Avoid basic media forming insoluble carbonate. The sulfide, basic carbonate, oxalate, phosphate, arsenite, arsenate and iodide are insoluble in water.

**Stability** - 2-100 ppb levels not stable in 1% HNO<sub>3</sub> / LDPE container, stable in 10% HNO<sub>3</sub> packaged in borosilicate glass. 1-100 ppm levels stable in 7% HNO<sub>3</sub> packaged in borosilicate glass. 1000-10,000 ppm solutions are chemically stable for years in 5-10% HNO<sub>3</sub> / LDPE container.

**Hg Containing Samples (Preparation and Solution)** - Metal (soluble in HNO<sub>3</sub>); Oxide (Soluble in HNO<sub>3</sub>); Ores and Organic based (The literature has more references to the preparation of Hg containing samples than any other element. Please consult the literature for your specific sample type, since such preparations are prone to error. Or e-mail our technical staff and we will contact you to discuss your particular sample preparation questions in further detail.).

**Atomic Spectroscopic Information (ICP-OES D.L.s are given as radial/axial view):**

Technique/Line	Estimated D.L.	Order	Interferences (underlined indicates severe)
ICP-MS 202 amu	9 ppt	n/a	186W16O
ICP-OES 184.950 nm	0.03 / 0.005 µg/mL	1	
ICP-OES 194.227 nm	0.03 / 0.005 µg/mL	1	V
ICP-OES 253.652 nm	0.1 / 0.03 µg/mL	1	Ta, Co, Th ,Rh , Fe, U

## **8.0 HAZARDOUS INFORMATION**

- Please refer to the Safety Data Sheet for information regarding this CRM/RM.

## **9.0 HOMOGENEITY**

- This solution was mixed according to an in-house procedure and is guaranteed to be homogeneous. Homogeneity data indicate that the end user should take a minimum sample size of 0.2 mL to assure homogeneity.

## **10.0 QUALITY STANDARD DOCUMENTATION**

### **10.1 10CFR50 Appendix B - Nuclear Regulatory Commission**

- Domestic Licensing of Production and Utilization Facilities

### **10.2 10CFR21 - Nuclear Regulatory Commission**

- Reporting defects and Non-Compliance

### **10.3 ISO 9001 Quality Management System Registration**

- SAI Global File Number 010105

### **10.4 ISO/IEC Guide 17025 "General Requirements for the Competence of Testing and Calibration Laboratories"**

- Chemical Testing - Accredited / A2LA Certificate Number 883.01

**10.5 ISO/IEC Guide 34 "General Requirements for the Competence of Reference Material Producers"**

- Reference Material Producer - Accredited / A2LA Certificate Number 883.02

**11.0 CERTIFICATION, LOT EXPIRATION AND PERIOD OF VALIDITY**

**11.1 Certification Issue Date**

October 13, 2015

- The certification is valid within the measurement uncertainty specified provided the CRM/RM is stored and handled in accordance with instructions given in Sec 7.1. This certification is nullified if instructions in Sec 7.1 are not followed or if the CRM/RM is damaged, contaminated, or otherwise modified.

**11.2 Lot Expiration Date**

- **October 13, 2018**

- The date after which this CRM/RM should not be used.
- The lot expiration date reflects the period of time that the stability of a CRM/RM can be supported by long term stability studies conducted on properly stored and handled CRM/RMs. Lot expiration is limited primarily by transpiration (loss of water from the solution) and infrequently by chemical stability.

**11.3 Period of Validity**

- Sealed TCT Bag Open Date: \_\_\_\_\_

- This CRM/RM should not be used longer than one year from the date of removal from the aluminized bag or after the date given in Sec. 11.2, whichever comes first. This is contingent upon the CRM/RM being handled and stored in accordance with the instructions given in Sec 7.1.

**12.0 NAMES AND SIGNATURES OF CERTIFYING OFFICERS**

**Certificate Prepared By:**

Maurice Harris  
Product Documentation Technician

**Certificate Approved By:**

Brian Alexander  
PhD., Technical Process Director

**Certifying Officer:**

Paul Gaines  
PhD., Senior Technical Director

Reagent

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**NRM-4\_00001**

**Location of Entire Document:** \\slsrv01\Certificates of Analysis

## **Soil-Based Uranium Disequilibrium and Mixed Uranium-Thorium Series Radionuclide Reference Materials**

**Stephen Donivan  
Ronald Chessmore**

**Published December 1988**

**UNC Geotech  
Grand Junction, Colorado 81502**

**Prepared for  
U.S. Department of Energy  
Grand Junction Projects Office  
Under Contract No. DE-AC07-86ID12584**

## Summary

The U.S. Department of Energy (DOE) Office of Remedial Action and Waste Technology has assigned the Technical Measurements Center (TMC), located at the DOE Grand Junction, Colorado, Projects Office and operated by UNC Geotech (UNC), the task of supporting ongoing remedial action programs by providing both technical guidance and assistance in making the various measurements required in all phases of remedial action work.

Pursuant to this task, the Technical Measurements Center prepared two sets of radionuclide reference materials for use by remedial action contractors and cognizant Federal and State agencies. A total of six reference materials, two sets comprising three reference materials each, were prepared with varying concentrations of radionuclides using mill tailings materials, ores, and a river-bottom soil diluent. One set (disequilibrium set) contains varying amounts of uranium with nominal amounts of radium-226. The other set (mixed-nuclide set) contains varying amounts of uranium-238 and thorium-232 decay series nuclides.

All materials were ground, dried, and blended thoroughly to ensure homogeneity. The analyses on which the recommended values for nuclides in the reference materials are based were performed, using independent methods, by the UNC Geotech Analytical Chemistry Laboratory at the DOE Grand Junction Projects Office and by C. W.

Sill of the Idaho National Engineering Laboratory, Idaho Falls, Idaho.

Several statistical tests were performed on the analytical data to characterize the reference materials. Results of these tests show that the six reference materials are homogeneous and that no large systematic bias exists between the analytical methods used by UNC and those used by Sill. The average values for radionuclides of the two data sets, representing an unbiased estimate, were used as the recommended values for concentrations of nuclides in the reference materials. The recommended concentrations of radionuclides in the six reference materials are presented in Table 8.

The reference materials will help provide uniform standardization among measurements made by remedial action contractors. The reference materials are available free of charge to remedial action contractors and to Federal and State agencies involved in DOE remedial action programs.

Companion sets of radium-226,<sup>1</sup> thorium-232,<sup>2</sup> and uranium<sup>3</sup> reference materials were previously prepared and are also available from the Technical Measurements Center. The reference materials are available by contacting the Technical Measurements Center, 2597 B 3/4 Road, Grand Junction, Colorado 81502-5504; telephone (303) 248-6702 or FTS 326-6702.

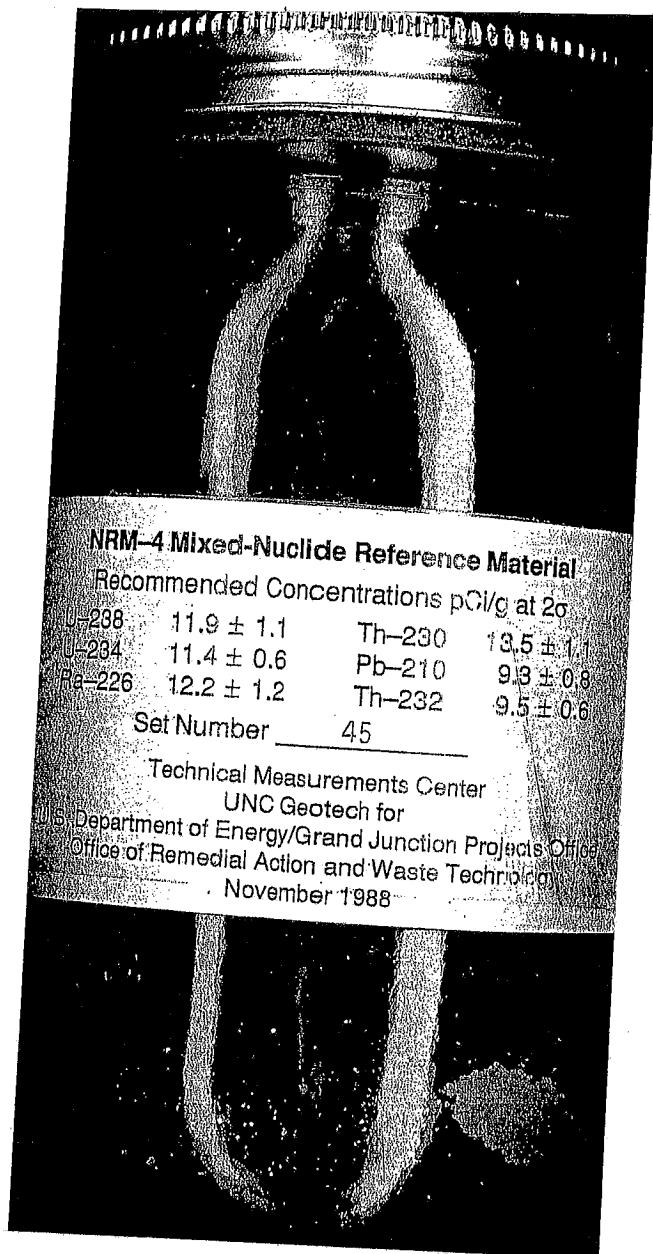
*Table 8. Recommended Concentrations of Nuclide Reference Materials*

Reference Material	Concentration (pCi/g)					
	U-238	U-234	Ra-226	Th-230	Pb-210	Th-232
<b>Disequilibrium Set</b>						
NRM-1	15.4 ± 0.5	15.2 ± 0.6	1.1 ± 0.1			
NRM-2	43.9 ± 1.6	43.5 ± 1.3	1.1 ± 0.1			
NRM-3	86.3 ± 4.4	85.3 ± 3.9	1.1 ± 0.1			
<b>Mixed-Nuclide Set</b>						
NRM-4	11.9 ± 1.1	11.4 ± 0.6	12.2 ± 1.2	13.5 ± 1.1	9.3 ± 0.8	9.5 ± 0.6
NRM-5	22.6 ± 1.6	22.2 ± 1.7	22.7 ± 1.9	25.5 ± 1.8	16.8 ± 1.7	18.0 ± 1.1
NRM-6	42.9 ± 3.4	42.4 ± 2.8	44.6 ± 2.2	49.7 ± 2.9	32.4 ± 3.3	34.4 ± 1.1

*Table 9. Homogeneity Study Results of Disequilibrium Set Reference Materials*

	Concentration of U-238 (pCi/g)					
	NRM-1		NRM-2		NRM-3	
	Within	Random	Within	Random	Within	Random
	15.2	14.8	41.4	41.9	79.8	78.9
	14.6	15.1	41.9	41.5	80.6	82.4
	14.8	15.0	41.6	42.1	79.9	80.6
	15.0	15.3	41.4	41.5	81.3	78.3
	14.8	15.2	41.2	41.5	79.1	76.8
	14.9	15.4	41.2	41.2	81.4	82.8
	14.9	14.9	41.8	42.2	80.4	83.2
	15.1	15.4	41.2	41.1	84.8	79.8
	14.6	15.2	41.8	41.8	81.6	81.3
	15.3	14.9	41.6	41.7	83.2	79.2
Mean	14.9	15.1	41.5	41.7	81.2	80.3
Standard Deviation <sup>a</sup>	0.23	0.23	0.5	0.7	3.3	4.1
t Statistic	0.94		1.15		-1.03	
Critical Value	1.73		1.73		1.73	
F Statistic	1.19		2.04		1.52	
Critical Value	3.18		3.18		3.18	

<sup>a</sup>Experimental standard deviation at the 95 percent confidence level.



Reagent

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**Th-229\_00016**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

97790

Th-229 5 mL Liquid in Flame Sealed Vial



430569  
 ID: Th-229\_00016  
 Exp:08/06/14 Prpd:SCB Cpn:08/20/14  
 Th-229 Ampoule

**Customer:** TestAmerica - St. Louis  
**P.O. No.:** 2573570, Item 1      Product Code: 8229

This standard radionuclide source was prepared gravimetrically from a master solution, calibrated by Eckert & Ziegler Analytics. The master solution was calibrated by liquid scintillation counting. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Isotope	Half-Life, Days	Activity (Bq)	Uncertainty*, %			Reference Date (12:00 PM EST)	
			Type	u <sub>A</sub>	u <sub>B</sub>		
Th-229	2.681E+06	3.761E+03		0.5	1.5	3.1	08/06/2014

\***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

**Comments:**

Impurities:  $\alpha$ -impurities: Th-228 2.83E-01 Bq, Th-230 2.33E+01 Bq, Th-232 1.51E0 Bq;  $\gamma$ -impurities (other than decay products)<0.1%.

5.08156 g 0.5M HNO<sub>3</sub> solution. Carrier free.

Source Prepared by:

  
 Z. Dimitrova, Radiochemist

QC Approved:

  
 A. Chen, Spectroscopist

Date: 06 AUG 14





**U.S. DEPARTMENT OF COMMERCE**  
National Institute of Standards & Technology  
Gaithersburg, MD 20899

## Certificate of Participation

*Eckert & Ziegler Analytics  
Atlanta, Georgia*

is a participant for the period January 1, 2014, through December 31, 2014, in a radioactivity measurements assurance program conducted by the National Institute of Standards and Technology, in cooperation with NRMAP Incorporated. Continued participation is evidenced by dated Reports of Traceability issued for particular radionuclides, which indicate the deviation of the participant's reported value from that measured by the National Institute of Standards and Technology. The significance of these Reports is addressed below.\*

For the Director,

Michael P. Unterweger, Leader  
Radioactivity Group  
Physical Measurement Laboratory

\* As guidance for the proper use of Reports of Traceability, it should be emphasized that the National Institute of Standards and Technology is concerned only with fostering good measurements capability and consistency with the national measurements system. The assurance of the proper application of that capability to the ultimate consumer products is the responsibility of each manufacturer of these products and of the Federal regulatory agencies.

A continuing traceability program in radioactivity demonstrates, to the degree established by the periodic assays of calibrated radioactivity samples, a continuing competence to maintain the methods and standards necessary for accurate measurement. Such a program cannot, however, endorse each and every measurement nor the final product, any more than a spot check can vouch for every unchecked item. Care should be taken, therefore, not to imply such endorsement. The proper use of this Report is governed by section 200.114 of Title 15 of the Code of Federal Regulations. These regulations may be met if Reports are quoted only in their entirety. Excerpts out of context may be misleading.



## Recommended Procedure for Opening the Flame Sealed Vial

- 1) If the solution is to be diluted, it is recommended that the diluting solution have a composition comparable to that of the standard.
- 2) Wear eye protection, gloves, and protective clothing and work over a tray with absorbent paper in it. Work in a fume hood.
- 3) Shake the vial to wet the entire inside surface of the vial. Return the vial to the upright position.
- 4) Check that all of the liquid has drained out of the neck of the vial. If necessary, gently tap the neck to speed the process.
- 5) The Wheaton vials we use are pre-scored.
- 6) Lightly wet the scored line. This reduces the crack propagation velocity and makes for a cleaner break.
- 7) Hold the vial upright and wrap with soft tissue, such as Chem Wipes, around the tip of the vial and secure with tape (see picture). Snap off the top of the vial by pressing the pre-scored part of the neck away towards you while pulling the tip of the vial away from you.
- 8) Transfer the solution from the vial using a pycnometer or pipet with a dispenser handle. NEVER PIPETTE BY MOUTH.
- 9) Seal any unused solution in a flame sealed glass vial, if possible, to minimize the evaporation loss.

Reagent

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**Th-229\_00021**

Standard ID Number: Th-229\_00021  
True Value = 67.217 Dpm/mL  
Date Analyzed: 8/1/2016

Radionuclide: Th-229

Replicates  
#1 65.43 Dpm/mL  
#2 62.76 Dpm/mL  
#3 66.9 Dpm/mL

Mean = 65.03

1 sigma = 2.09878536      1.96 sigma = 4.113619

True Value minus 5% = 63.85615      (True Value - 5%)  
True Value plus 5% = 70.57785      (True Value + 5%)

**Accuracy:**

Mean value within 5% of Certified (True) Value? Yes (Acceptance Criteria)

**Precision:**

1.96 sigma Value Within 10% of Mean Value? Yes (Acceptance Criteria)

**Standard Reverification Acceptable?**

Yes

Note: Criteria for reverification of radiological standards is taken from the  
DoD/DOE Consolidated QSM and LANL Statements of Work

1st Reviewed By/Date: ALD 8/2/16

2nd Reviewed By/Date: RW 8-3-16



**Reagent ID:** Th-229\_00021

Description: Th-229 Tracer  
 No. of Bottles: 1  
 Storage Location: RAD Actinide STDs  
 Reagent Volume: 500.000 mL  
 Creation Date: 07/20/2016  
 Open Date:  
 Container(s): 957642  
 Comment:

Expiration Date: 12/01/2016  
 Laboratory: TestAmerica St. Louis  
 Prepared By: Bernsen, Sarah C  
 Solvent: 0.1M HNO3  
 Solvent Lot: n/a

#### Reagent Analyte Information

Analyte	Source ID	Source Exp. Date	Source Conc.	Source Conc. Units	Final Conc.	Final Conc. Units
At-217	Th-229_00017	08/05/2016	2240.98600	dpm/mL	67.22958	dpm/mL
Th-229	Th-229_00017	08/05/2016	2240.98600	dpm/mL	67.22958	dpm/mL

#### Source Reagents

Reagent	Description	Type	Expiration	Vendor	Vendor Lot #	Vendor Cat Lot #	Volume Used	Volume Units
Th-229_00017	Th-229 Parent		08/05/16				15.00000	mL

**Decay Calculations****Raw Sample/Standard Information**

<b>Initial Date/Time (<math>t_0</math>):</b>	8/6/2014 0:00		
<b>Decayto Date/Time (t):</b>	8/1/16 0:00		
<b>Initial Activity (<math>A_0</math>):</b>	67.23	dpm	
<b>Initial Aliquot:</b>	1	mL	
<b>Initial Conc:</b>	67.229	dpm/mL	
<b>*Soln. Density:</b>	1	g/mL	
<b>Nuclide:</b>	Th-229		
<b>Half-Life (days):</b>	2897163	decay days	
<b>**Decay Factor:</b>	0.9998	726.00	0.00025
<b>Decay Corr Activity:</b>	6.7217E+01	dpm	
<b>Decay Corr Conc:</b>	6.7217E+01	dpm/mL	

**Conversion/Calculations**

<b>Final Activity Unit:</b>	dpm
<b>Activity Unit Factor:</b>	1.00000
<b>Final Volume Unit:</b>	mL
<b>Volume Unit Factor:</b>	1.000
<b>Final Concentration:</b>	6.7217E+01 dpm/mL
<b>Aliquot Volume:</b>	1.0000E+00 mL
<b>Final Activity (A):</b>	6.7217E+01 dpm

\*\* Uses basic decay equation:  $A = A_0 * \exp(-\ln(2)*(t-t_0)/(half-life))$

\* Soln. Density to be used when converting from liquid expressed in mass (g) units to liquid units (mL), and is only applied in that case.

Sample Name: Verification 1  
 Spectrum #1 Analysis #1

Type: Sample

**Sample**

Sample Volume : 0.10

Sample Units: mL

Sample Collection Date:

Comment:

First Stage Dilution: N/A

Aliquot: N/A Aliquot Fraction: N/A

Dilution 2: N/A

Lab Preparation:

Batch Name: Th-229\_00021

AnalysisResultsID: 172960

Description:

**Batch**

Client Name: Undefined

Client Contact:

Analyst: 60040

Tracer Name: Th-230\_00029

Tracer Activity: 44.56 DPM / mL x (Vol.) 0.30 mL = 13.37 DPM

Tracer Ref. Date: 8/8/2013 11:19:32AM

**Tracer**

Tracer Nuclide: Th-230

Tracer Recovery: 97.09%

Detector: AV170 SN: 50-112 G7

Acquisition Start Date: 8/1/2016 2:01:38PM

Live Time: 960.00 min.

Real Time: 960.01 min.

Background Date: 7/25/2016 1:14:05PM

Bkgd Info: Sample: ICB;AV170; Det: AV170; Spectrum #1; 7/25/2016 1:14:05 PM

**Acquisition**

Energy Calibration: IC-9795;AV170-20151016

Efficiency Calibration:IC-9795;AV170-20151016

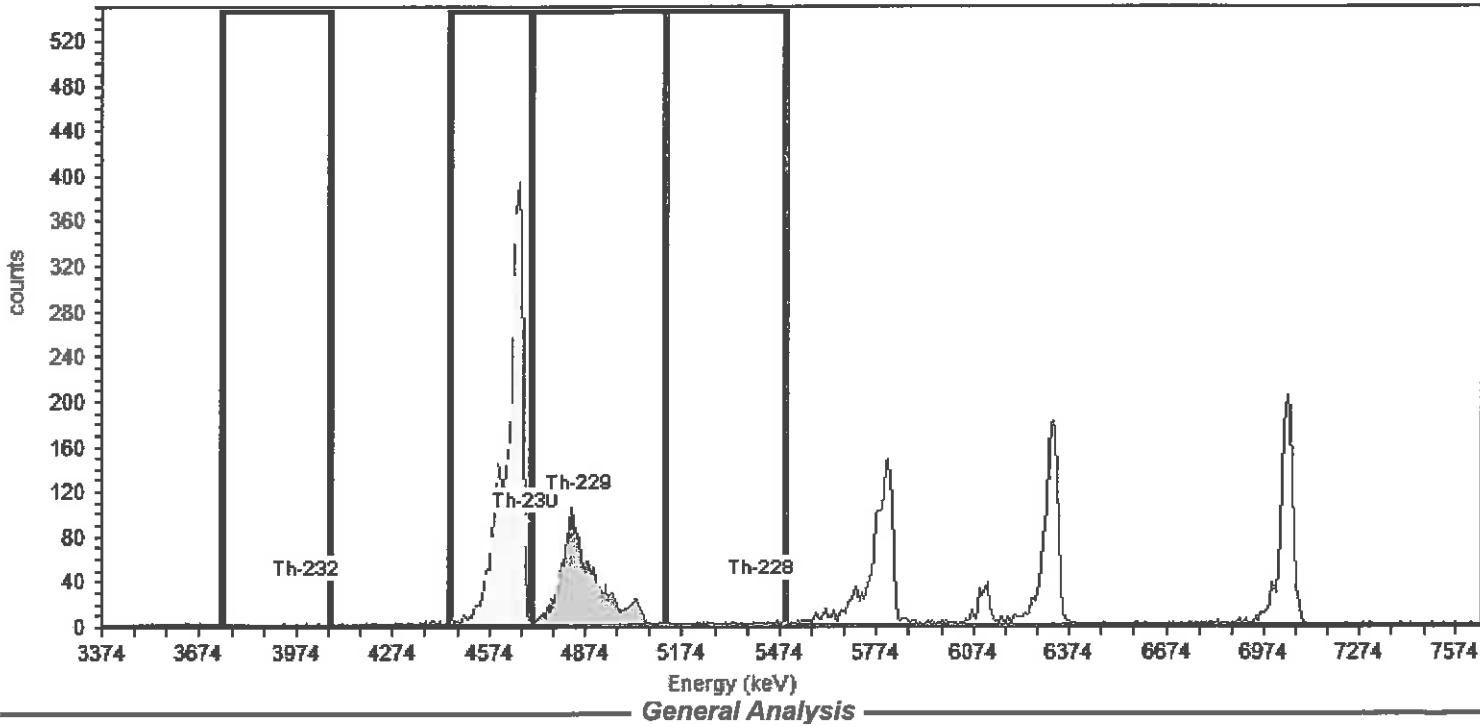
Calibration Date: 10/17/2015 2:36:50PM

Energy Cal: Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency: 25.95% +/- 0.34% TPU(2 sigma)


**General Analysis**

Analysis Method: Interactive ROI Analysis

Decay Correction: 8/1/2016 2:00:42PM

MDA Constants: K $\alpha$  = 1.64 , K $\beta$  = 1.64

Nuclide Library: Thorium

MDA Source: Background

**Nuclide Summary (ROI)**

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	9.9	100.2	4	0.0000	4.00	1.650E-001	DPM/mL
Th-230	4688.0	4,687.5	0.5	4448.3	4701.9	22.4	99.7	3225	1.0000	3224.00	1.298E+002	DPM/mL
Th-229	4848.0	4,845.3	2.7	4701.9	5119.5	98.2	99.6	1580	3.0000	1577.00	6.543E+001	DPM/mL
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	28.8	99.8	30	18.0000	12.00	4.973E-001	DPM/mL

Sample Name: Verification 2  
Spectrum #1 Analysis #1

Type: Sample

**Sample**

Sample Volume : 0.10

Sample Units: mL

Sample Collection Date:  
Comment:

First Stage Dilution: N/A

Aliquot: N/A Aliquot Fraction: N/A

Dilution 2: N/A

Lab Preparation:

Batch Name: Th-229\_00021  
AnalysisResultsID: 172958  
Description:

**Batch**

Client Name: Undefined

Client Contact:

Analyst: 60040

Tracer Name: Th-230\_00029

**Tracer**

Tracer Activity: 44.56 DPM / mL x (Vol.) 0.30 mL = 13.37 DPM

Tracer Nuclide: Th-230

Tracer Ref. Date: 8/8/2013 11:19:32AM

Tracer Recovery: 105.76%

Detector: AV171 SN: 50-112 Y2

**Acquisition**

Acquisition Start Date: 8/1/2016 2:01:38PM

Energy Calibration: IC-9817;AV171-20151016

Live Time: 960.00 min.

Efficiency Calibration:IC-9817;AV171-20151016

Real Time: 960.00 min.

Calibration Date: 10/17/2015 2:36:53PM

Background Date: 7/22/2016 3:43:34PM

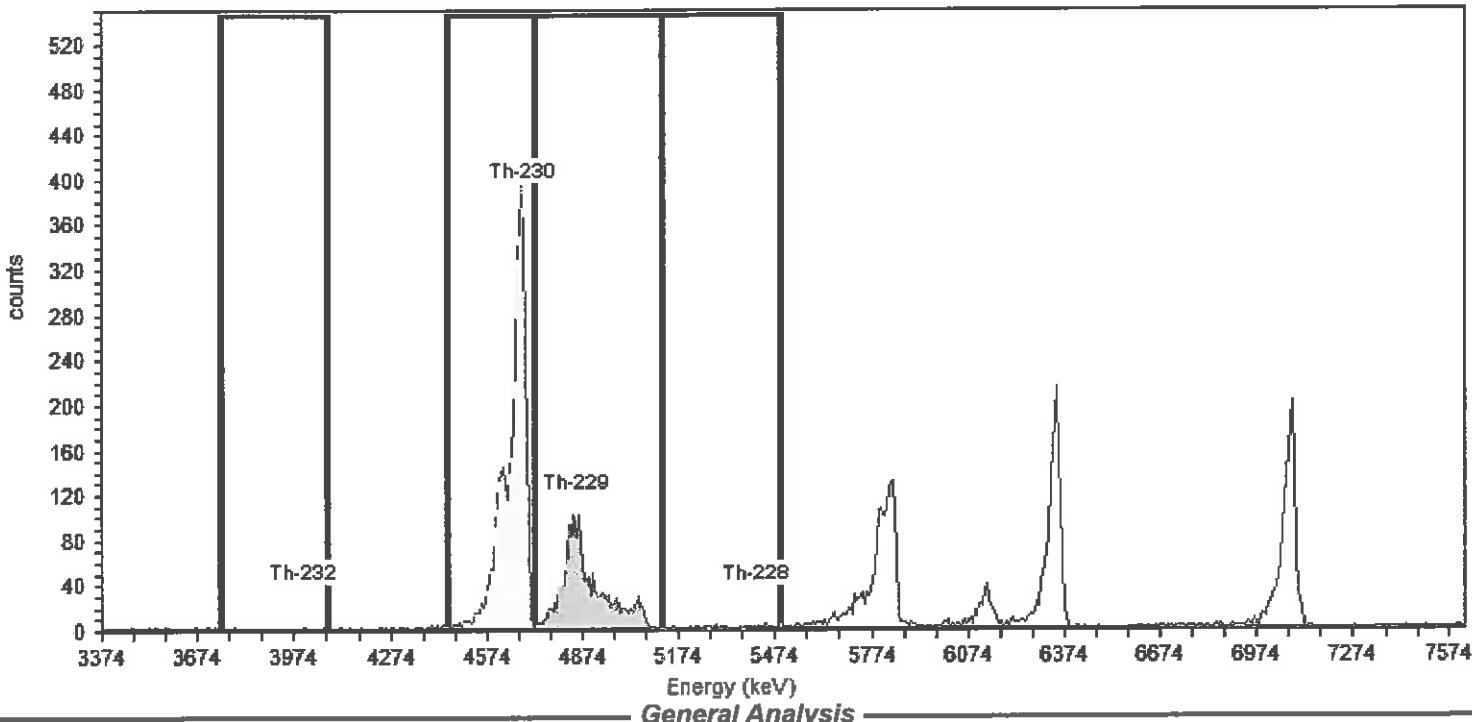
Energy Cal: Gain = 7.4575 keV / Ch

Bkgd Info: Sample: ICB;AV171; Det: AV171; Spectrum #1; 7/22/2016  
3:43:34 PM

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency: 24.59% +/- 0.30% TPU(2 sigma)

**General Analysis**

Analysis Method: Interactive ROI Analysis

Nuclide Library: Thorium

Decay Correction: 8/1/2016 2:00:42PM

MDA Source: Background

MDA Constants: K<sub>α</sub> = 1.64, K<sub>β</sub> = 1.64**Nuclide Summary (ROI)**

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Th-229	4848.0	4,845.3	2.7	4724.2	5119.5	77.3	99.6	1565	4.0000	1561.00	6.276E+001	DPM/mL
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	16.4	99.8	40	19.0866	20.65	8.294E-001	DPM/mL
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	322.3	100.2	4	2.0000	1.85	7.397E-002	DPM/mL
Th-230	4688.0	4,687.5	0.5	4448.3	4724.2	31.3	99.7	3327	0.0000	3327.00	1.414E+002	DPM/mL

## Alpha-Spectroscopy Analysis Report

TestAmerica St. Louis  
13715 Rider Trail North  
Earth City, MO 63045  
8:58:04AM 8/2/2016

Sample Name: Verification 3  
Spectrum #1 Analysis #1

Sample Collection Date:  
Comment:

Batch Name: Th-229\_00021  
AnalysisResultsID: 172954  
Description:

Tracer Name: Th-230\_00029  
Tracer Activity: 44.56 DPM / mL x (Vol.) 0.30 mL = 13.37 DPM  
Tracer Ref. Date: 8/8/2013 11:19:32AM

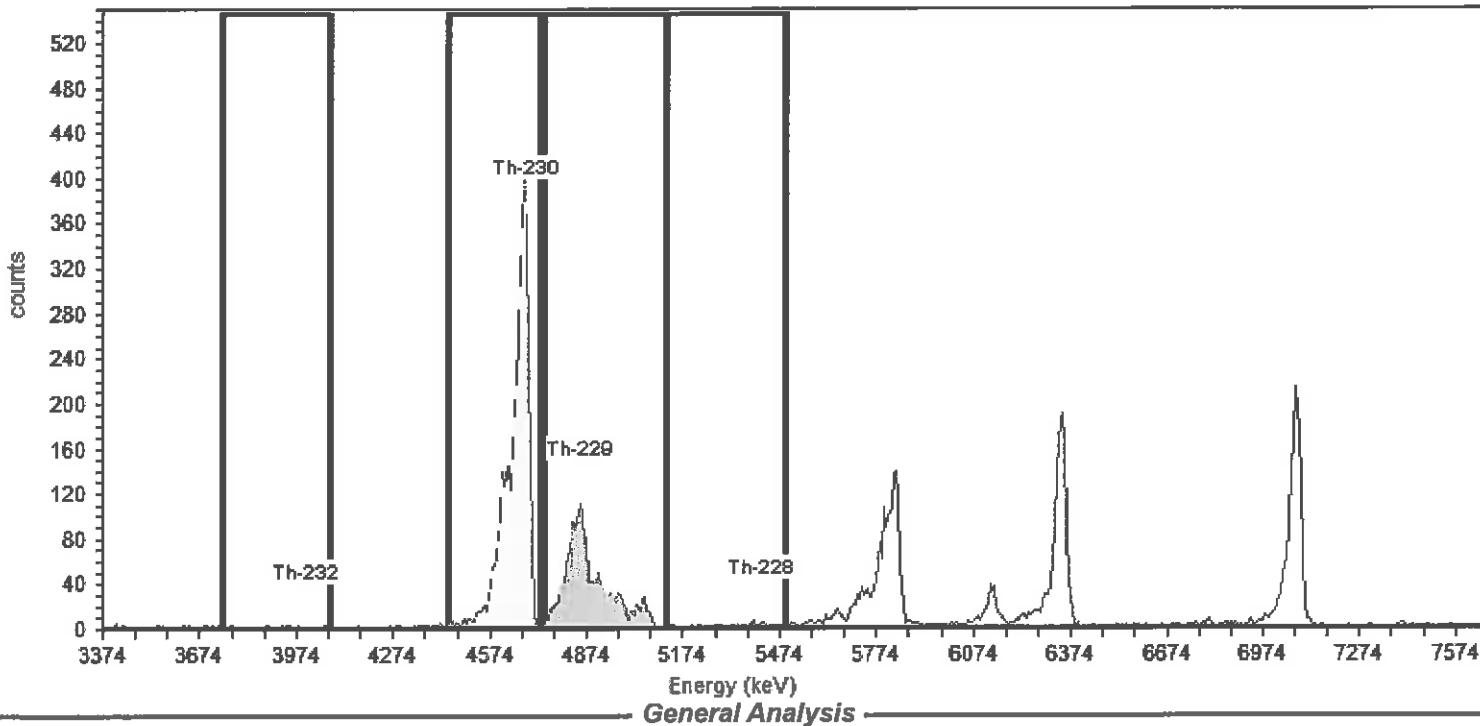
Detector: AV173 SN: 50-112 Y4  
Acquisition Start Date: 8/1/2016 2:01:39PM  
Live Time: 960.00 min.  
Real Time: 960.00 min.  
Background Date: 7/25/2016 1:14:05PM  
Bkgd Info: Sample: ICB; Det: AV173; Spectrum #1; 7/25/2016 1:14:05 PM

Sample Volume : 0.10  
First Stage Dilution: N/A  
Aliquot: N/A Aliquot Fraction: N/A  
Dilution 2: N/A  
Lab Preparation:

Client Name: Undefined  
Client Contact:  
Analyst: 60040

Tracer Nuclide: Th-230  
Tracer Recovery: 101.01%

Energy Calibration: IC-9885;AV173-20151016a  
Efficiency Calibration:IC-9885;AV173-20151016a  
Calibration Date: 10/17/2015 2:37:06PM  
Energy Cal: Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency: 25.59% +/- 0.38% TPU(2 sigma)



Analysis Method: Interactive ROI Analysis  
Decay Correction: 8/1/2016 2:00:42PM  
MDA Constants: K $\alpha$  = 1.64 , K $\beta$  = 1.64

Nuclide Library: Thorium  
MDA Source: Background

### Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	10.3	100.2	8	2.0000	5.57	2.243E-001	DPM/mL
Th-230	4688.0	4,687.5	0.5	4440.8	4731.7	47.8	99.7	3309	2.0000	3307.00	1.350E+002	DPM/mL
Th-229	4848.0	4,845.3	2.7	4739.1	5119.5	76.7	99.6	1657	3.0000	1654.00	6.690E+001	DPM/mL
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	105.5	99.8	42	12.9361	28.98	1.171E+000	DPM/mL

# Th-229 Tracer (New) — Aliquot Only by Coppt.

Batch No.:

Note: If a tracer is being used, mark this box and initial & date next to the N.A.  
i.e. "Mark this": A box if a tracer is not added to the samples(s) then  
initial and date next to the N.A.

Balance ID #:

Sample Number	Aliquot (g/ml)	Crucible ID	Dilution
1	VER 1	170	
2	1/2	171	
3	1/3	173	
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

Tracer	<input type="checkbox"/> N/A	Initials / Date
Isotope:	Th-229	
Std Sol'n ID.:	Th-229-	
Vol (mL):	0.3	
Ref Activity (dpm/mL):		
Act Ref Date:		

LCS Standard	<input type="checkbox"/> N/A	Initials / Date
Isotope:	Th-229	
Std Sol'n ID.:	Th-229-00021	
Vol (mL):	0.1	
Ref Activity (dpm/mL):	229	
Act Ref Date:	08-OCT-14	

SOP's applied in preparing these samples. Mark box to left for all that apply:

<input type="checkbox"/> ST-RC-0003 Rev.	<input type="checkbox"/> ST-RC-0040 Rev.	<input type="checkbox"/> ST-RC-0110 Rev.
<input type="checkbox"/> ST-RC-0004 Rev.	<input type="checkbox"/> ST-RC-0041 Rev.	<input type="checkbox"/> ST-RC-0120 Rev.
<input type="checkbox"/> ST-RC-0014 Rev.	<input type="checkbox"/> ST-RC-0050 Rev.	<input type="checkbox"/> ST-RC-0232 Rev.
<input type="checkbox"/> ST-RC-0020 Rev.	<input type="checkbox"/> ST-RC-0090 Rev.	<input type="checkbox"/> ST-RC-0238 Rev.
<input type="checkbox"/> ST-RC-0021 Rev.	<input checked="" type="checkbox"/> ST-RC-0100 Rev.	<input type="checkbox"/> ST-RC-0240 Rev.
		<input type="checkbox"/> ST-RC-0241 Rev.
		<input checked="" type="checkbox"/> ST-RC-0242 Rev.
		<input type="checkbox"/> ST-RC-0244 Rev.
		<input type="checkbox"/> ST-RC-5016 Rev.
		<input type="checkbox"/>
		<input type="checkbox"/>

Isotope(s)

αβ	Iso Pu	Iso Ra	Tc-99	Iso Cm
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Iso Th	<input type="checkbox"/> Pu-241
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Sr	<input type="checkbox"/> Iso U	<input type="checkbox"/> Th-229
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> TAR	<input type="checkbox"/> C-14	<input type="checkbox"/> Cl-36
<input type="checkbox"/>	<input type="checkbox"/>			

Count Time	Matrix
<input checked="" type="checkbox"/> Long Count	<input type="checkbox"/> Soil
<input type="checkbox"/> Short Count	<input type="checkbox"/> H <sub>2</sub> O

Prepared By : \_\_\_\_\_  
Date : \_\_\_\_\_

Reviewed by: \_\_\_\_\_  
Date: \_\_\_\_\_

# **METALS**

COVER PAGE  
METALS

Lab Name: TestAmerica St. Louis Job Number: 160-18521-2

SDG No.: Headworks/9720-8

Project: ORNL Y-12 Outfall 200 Characterization

Client Sample ID  
YMTFA74SE001  
YMTFA75SE001

Lab Sample ID  
160-18521-1  
160-18521-2

Comments:

1A-IN  
INORGANIC ANALYSIS DATA SHEET  
METALS - TCLP

Client Sample ID: YMTFA74SE001

Lab Sample ID: 160-18521-1

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG ID.: Headworks/9720-8

Matrix: Solid

Date Sampled: 08/05/2016 07:50

Reporting Basis: WET

Date Received: 08/06/2016 08:30

CAS No.	Analyte	Result	RL	MDL	Units	C	Q	DIL	Method
7439-97-6	Mercury	0.0022	0.0010	0.000079	mg/L		B	1	7470A

1A-IN  
INORGANIC ANALYSIS DATA SHEET  
METALS - TCLP

Client Sample ID: YMTFA75SE001

Lab Sample ID: 160-18521-2

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG ID.: Headworks/9720-8

Matrix: Solid

Date Sampled: 08/05/2016 09:25

Reporting Basis: WET

Date Received: 08/06/2016 08:30

CAS No.	Analyte	Result	RL	MDL	Units	C	Q	DIL	Method
7439-97-6	Mercury	0.000079	0.0010	0.000079	mg/L	U		1	7470A

2A-IN  
CALIBRATION VERIFICATIONS  
METALS

Lab Name: TestAmerica St. Louis Job No.: 160-18521-2  
SDG No.: Headworks/9720-8  
ICV Source: Hg QC Int.\_00736 Concentration Units: ug/L  
CCV Source: Hg Curve Int.\_00756

Analyte	ICV 160-267626/7 08/31/2016 15:30				CCV 160-267626/68 08/31/2016 17:36				CCV 160-267626/80 08/31/2016 18:01			
	Found	C	True	%R	Found	C	True	%R	Found	C	True	%R
<b>Mercury</b>	4.91		5.00	98	5.00		5.00	100	4.99		5.00	100

Note! Calculations are performed before rounding to avoid round-off errors in calculated results.  
Italicized analytes were not requested for this sequence.

2A-IN  
CALIBRATION VERIFICATIONS  
METALS

Lab Name: TestAmerica St. Louis Job No.: 160-18521-2  
SDG No.: Headworks/9720-8  
ICV Source: Hg QC Int.\_00736 Concentration Units: ug/L  
CCV Source: Hg Curve Int.\_00756

Analyte	CCV 160-267626/92 08/31/2016 18:27											
	Found	C	True	%R	Found	C	True	%R	Found	C	True	%R
<b>Mercury</b>	4.94		5.00	99								

Note! Calculations are performed before rounding to avoid round-off errors in calculated results.  
Italicized analytes were not requested for this sequence.

3-IN  
INSTRUMENT BLANKS  
METALS

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Concentration Units: ug/L

Analyte	RL	ICB 160-267626/8 08/31/2016 15:32		CCB 160-267626/69 08/31/2016 17:38		CCB 160-267626/81 08/31/2016 18:04		CCB 160-267626/93 08/31/2016 18:29	
		Found	C	Found	C	Found	C	Found	C
<b>Mercury</b>	0.20	0.060	U	0.060	U	0.060	U	0.060	U

Italicized analytes were not requested for this sequence.

3-IN  
METHOD BLANK  
METALS - TCLP

Lab Name: TestAmerica St. Louis Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Concentration Units: mg/L Lab Sample ID: LB 160-267256/1-B

Instrument Code: HAA2 Batch No.: 267626

CAS No.	Analyte	Concentration	C	Q	Method
7439-97-6	Mercury	0.000110	J		7470A

5A-IN  
MATRIX SPIKE SAMPLE RECOVERY  
METALS - TCLP

Client ID: YMTFA74SE001 MS

Lab ID: 160-18521-1 MS

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Matrix: Solid

Concentration Units: mg/L

% Solids: \_\_\_\_\_

Analyte	SSR C	Sample Result (SR) C	Spike Added (SA)	%R	Control Limit %R	Q	Method
Mercury	0.0261	0.0022	0.0250	95	70-130		7470A

SSR = Spiked Sample Result

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VA - IN

5A-IN  
MATRIX SPIKE DUPLICATE SAMPLE RECOVERY  
METALS - TCLP

Client ID: YMTFA74SE001 MSD

Lab ID: 160-18521-1 MSD

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Matrix: Solid

Concentration Units: mg/L

% Solids: \_\_\_\_\_

Analyte	(SDR)	C	Spike Added (SA)	%R	Control Limit %R	RPD	RPD Limit	Q	Method
Mercury	0.0263		0.0250	96	70-130	1	20		7470A

SDR = Sample Duplicate Result

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VD - IN

7A-IN  
LAB CONTROL SAMPLE  
METALS

Lab ID: LCS 160-267442/2-A

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

Sample Matrix: Water

LCS Source: Hg QC Int.\_00736

Analyte	Water (mg/L)						
	True	Found	C	%R	Limits	Q	Method
Mercury	0.0250	0.0240		96	80	120	7470A

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VIIA - IN

8-IN  
ICP-AES AND ICP-MS SERIAL DILUTIONS  
METALS - TCLP

Lab ID: 160-18521-1

SDG No: Headworks/9720-8

Lab Name: TestAmerica St. Louis Job No: 160-18521-2

Matrix: Solid Concentration Units: mg/L

Analyte	Initial Sample Result (I) C	Serial Dilution Result (S) C	% Difference	Q	Method
Mercury	0.0022	0.00133 J	NC		7470A

Calculations are performed before rounding to avoid round-off errors in calculated results.

FORM VIII-IN

9-IN  
DETECTION LIMITS  
METALS - TCLP

Lab Name: TestAmerica St. Louis

Job Number: 160-18521-2

SDG Number: Headworks/9720-8

Matrix: Solid      Instrument ID: HAA2

Method: 7470A      MDL Date: 06/28/2011 19:18

Prep Method: 7470A

Leach Method: 1311

Analyte	Wavelength/ Mass	RL (ug/L)	MDL (ug/L)
Mercury		1	0.079

9-IN  
CALIBRATION BLANK DETECTION LIMITS  
METALS - TCLP

Lab Name: TestAmerica St. Louis

Job Number: 160-18521-2

SDG Number: Headworks/9720-8

Matrix: Solid      Instrument ID: HAA2

Method: 7470A      XMDL Date: 06/28/2011 19:19

Analyte	Wavelength/ Mass	XRL (ug/L)	XMDL (ug/L)
Mercury		0.2	0.06

11-IN  
LINEAR RANGES  
METALS

Lab Name: TestAmerica St. Louis

Job No: 160-18521-2

SDG No.: Headworks/9720-8

Instrument ID: HAA2 Date: 08/11/2016 12:28

Analyte	Integ. Time (Sec.)	Concentration (ug/L)	Method
Mercury		10	7470A

12-IN  
PREPARATION LOG  
METALS

Lab Name: TestAmerica St. Louis Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Prep Method: 7470A

Lab Sample ID	Preparation Date	Prep Batch	Initial Weight	Initial Volume (mL)	Final Volume (mL)
LB 160-267256/1-B	08/31/2016 08:31	267442		6	30
LCS 160-267442/2-A	08/31/2016 08:31	267442		6	30
160-18521-1	08/31/2016 08:31	267442		6	30
160-18521-1 MS	08/31/2016 08:31	267442		6	30
160-18521-1 MSD	08/31/2016 08:31	267442		6	30
160-18521-2	08/31/2016 08:31	267442		6	30

13-IN  
ANALYSIS RUN LOG  
METALS

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Instrument ID: HAA2

Analysis Method: 7470A

Start Date: 08/31/2016 15:17

End Date: 08/31/2016 18:42

Lab Sample Id	D/F	T Y P E	Time	Analytes														
				H	G													
IC 160-267626/1			15:17	X														
IC 160-267626/2			15:19	X														
IC 160-267626/3			15:21	X														
IC 160-267626/4			15:23	X														
IC 160-267626/5			15:25	X														
IC 160-267626/6			15:27	X														
ICV 160-267626/7	1		15:30	X														
ICB 160-267626/8	1		15:32	X														
CRA 160-267626/9			15:35															
ZZZZZZ			15:37															
ZZZZZZ			15:39															
ZZZZZZ			15:41															
ZZZZZZ			15:43															
ZZZZZZ			15:45															
ZZZZZZ			15:47															
ZZZZZZ			15:49															
ZZZZZZ			15:52															
ZZZZZZ			15:54															
ZZZZZZ			15:56															
CCV 160-267626/20			15:59															
CCB 160-267626/21			16:01															
ZZZZZZ			16:03															
ZZZZZZ			16:05															
ZZZZZZ			16:07															
ZZZZZZ			16:09															
ZZZZZZ			16:11															
ZZZZZZ			16:13															
ZZZZZZ			16:15															
ZZZZZZ			16:17															
ZZZZZZ			16:19															
ZZZZZZ			16:21															
CCV 160-267626/32			16:22															
CCB 160-267626/33			16:24															
ZZZZZZ			16:27															
ZZZZZZ			16:29															
ZZZZZZ			16:31															
ZZZZZZ			16:33															
ZZZZZZ			16:35															
ZZZZZZ			16:37															
ZZZZZZ			16:38															
ZZZZZZ			16:40															
ZZZZZZ			16:42															

13-IN  
ANALYSIS RUN LOG  
METALS

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Instrument ID: HAA2

Analysis Method: 7470A

Start Date: 08/31/2016 15:17

End Date: 08/31/2016 18:42

Lab Sample Id	D/F	T Y P E	Time	Analytes														
				H	G													
ZZZZZZ			16:44															
CCV 160-267626/44			16:46															
CCB 160-267626/45			16:49															
ZZZZZZ			16:51															
ZZZZZZ			16:53															
ZZZZZZ			16:55															
ZZZZZZ			16:57															
ZZZZZZ			16:59															
ZZZZZZ			17:01															
ZZZZZZ			17:03															
ZZZZZZ			17:05															
ZZZZZZ			17:07															
ZZZZZZ			17:09															
CCV 160-267626/56			17:11															
CCB 160-267626/57			17:13															
ZZZZZZ			17:15															
ZZZZZZ			17:17															
ZZZZZZ			17:19															
ZZZZZZ			17:22															
ZZZZZZ			17:24															
ZZZZZZ			17:26															
ZZZZZZ			17:28															
ZZZZZZ			17:30															
ZZZZZZ			17:32															
ZZZZZZ			17:34															
CCV 160-267626/68	1	P	17:36	X														
CCB 160-267626/69	1	T	17:38	X														
ZZZZZZ			17:41															
ZZZZZZ			17:43															
ZZZZZZ			17:45															
ZZZZZZ			17:48															
ZZZZZZ			17:49															
ZZZZZZ			17:51															
ZZZZZZ			17:53															
ZZZZZZ			17:55															
LB 160-267256/1-B	1	P	17:57	X														
LCS 160-267442/2-A	1	T	17:59	X														
CCV 160-267626/80	1		18:01	X														
CCB 160-267626/81	1		18:04	X														
160-18521-1	1	P	18:06	X														
160-18521-1 SD	5	P	18:08	X														
160-18521-1 MS	1	P	18:10	X														

13-IN  
ANALYSIS RUN LOG  
METALS

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Instrument ID: HAA2 Analysis Method: 7470A

Start Date: 08/31/2016 15:17 End Date: 08/31/2016 18:42

Lab Sample Id	D/F	T Y p e	Time	Analytes															
				H	G														
160-18521-1 MSD		1	P	18:12	X														
160-18521-2		1	P	18:14	X														
ZZZZZZ				18:17															
ZZZZZZ				18:19															
ZZZZZZ				18:21															
ZZZZZZ				18:23															
ZZZZZZ				18:25															
CCV 160-267626/92		1		18:27	X														
CCB 160-267626/93		1		18:29	X														
ZZZZZZ				18:32															
ZZZZZZ				18:34															
ZZZZZZ				18:36															
CRA 160-267626/97				18:38															
CCV 160-267626/98				18:40															
CCB 160-267626/99				18:42															

Prep Types:

P = TCLP

T = Total/NA

## METALS BATCH WORKSHEET

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Batch Number: 267256

Batch Start Date: 08/11/16 13:18

Batch Analyst: Mcnutt, Joe W

Batch Method: 1311

Batch End Date: 08/12/16 12:31

Lab Sample ID	Client Sample ID	Method Chain	Basis	InitialAmount	FinalAmount	NumbSolidPhases	NumbLiqPhases	NumbTotPhases	EFD_SampleWeight
LB 160-267256/1		1311, 7470A, 7470A			2000 mL		1	1	
160-18521-B-1	YMTFA74SE001	1311, 7470A, 7470A	P	100.65 g	2000 mL	1		1	5 g
160-18521-D-2	YMTFA75SE001	1311, 7470A, 7470A	P	100.33 g	2000 mL	1		1	5 g

Lab Sample ID	Client Sample ID	Method Chain	Basis	EFD_VolumeWaterAdd	EFD_InitialpH	EFD_AddHClpH>5	EFD_HeatHeld	EFD_SecondpHCheck	ExtractionFluidOne
LB 160-267256/1		1311, 7470A, 7470A							4.96 SU
160-18521-B-1	YMTFA74SE001	1311, 7470A, 7470A	P	96 mL	6.44 SU	3.50 mL	10 min	1.71 SU	4.96 SU
160-18521-D-2	YMTFA75SE001	1311, 7470A, 7470A	P	96 mL	6.44 SU	3.50 mL	10 min	1.61 SU	4.96 SU

Lab Sample ID	Client Sample ID	Method Chain	Basis	FiltCompDate	LeachatepH	LeachVolume	ExtractFluid	AnalysisComment	
LB 160-267256/1		1311, 7470A, 7470A		8/12/16			1	pH<2 _M & _Hg	
160-18521-B-1	YMTFA74SE001	1311, 7470A, 7470A	P	8/12/16	6.44 SU	10 mL	1	pH<2 _M & _Hg	
160-18521-D-2	YMTFA75SE001	1311, 7470A, 7470A	P	8/12/16	5.80 SU	10 mL	1	pH<2 _M & _Hg	

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

## METALS BATCH WORKSHEET

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Batch Number: 267256

Batch Start Date: 08/11/16 13:18

Batch Analyst: Mcnutt, Joe W

Batch Method: 1311

Batch End Date: 08/12/16 12:31

Batch Notes	
1N HCl ID	901776
Balance ID	26950069
Batch Comment	(SPIKES) _M896089/896090 -Hg975881
Bottle Lot ID	06736
First End time	08/12/16 9:18
Lot # of Nitric Acid	976042
pH Meter Calibration Slope	100.6
pH Meter ID	A111
Room Temperature Thermometer ID	91037040
Analyst ID - Spike Analyst	JWM
Analyst ID - Spike Witness Analyst	MFM
First Start time	08/11/16 1456
TCLP Fluid 1 ID	967739
TCLP Fluid 1 pH	4.96
Thermometer ID	0801024473
Tumbler Rotations per Minute	30
Uncorrected Maximum Temperature	24.2 Degrees C
Uncorrected Minimum Temperature	21.4 Degrees C

Basis	Basis Description
P	TCLP

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

## METALS BATCH WORKSHEET

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Batch Number: 267442

Batch Start Date: 08/31/16 08:31

Batch Analyst: Shinn, Daniel A

Batch Method: 7470A

Batch End Date: 08/31/16 13:30

Lab Sample ID	Client Sample ID	Method Chain	Basis	InitialAmount	FinalAmount	Hg QC Int. 00736	TCLP HG SPK 00057		
LB 160-267256/1-A		7470A, 7470A		6 mL	30 mL				
LCS 160-267442/2		7470A, 7470A		6 mL	30 mL	1.5 mL			
160-18521-B-1-F	YMTFA74SE001	7470A, 7470A	P	6 mL	30 mL				
160-18521-B-1-F MS	YMTFA74SE001	7470A, 7470A	P	6 mL	30 mL		0.05 mL		
160-18521-B-1-F MSD	YMTFA74SE001	7470A, 7470A	P	6 mL	30 mL		0.05 mL		
160-18521-D-2-G	YMTFA75SE001	7470A, 7470A	P	6 mL	30 mL				

## Batch Notes

Hydroxylamine Sulfate ID	986115
Digestion End Time	13:00
Digestion Start Time	11:00
Lot # of hydrochloric acid	970158
Lot # of Nitric Acid	954989
Hot Block ID	HOTBLOCK HG1
Potassium Permanganate ID	986114
NaCl ID	621868
Oven, Bath or Block Temperature 1	92.2 Celsius
Oven, Bath or Block Temperature 2	93.7 Celsius
Pipette ID	MT002ANDMET05ANDMET10
Stannous Chloride ID	981569
Thermometer ID	111815895
Digestion Tube/Cup ID	229533-6417

Basis	Basis Description
P	TCLP

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

7470A

Page 1 of 1

TestAmerica St. Louis

**Hg Data Review Checklist**Method:  245.1  7470A  7471B

Instrument ID: HAA2

Analyst/1<sup>st</sup> Reviewer: Daniel Shinn

# Runs: \_\_\_\_\_ LIMS Batch Number: 267435 267439 267440 267441 267442 267443 267444

Filename: HAA083116A

Jobs:	680-129016	160-48521	160-18541	160-18612
160-18632	160-18659	160-18665	160-18670	160-18703
160-18738				

Review Items	NA	Yes	No	2 <sup>nd</sup> Rev	If No, why is data reportable? / Comments
<b>A. Calibration/Instrument Run QC</b>					
1. Instrument calibrated per lab SOP? (At least 5 standards and a blank)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
2. Linearity and intercept: $r \geq 0.995$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
3. ICV: Run before samples 95-105% recovery (245.1) 90-110% recovery (7470A/7471B)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> High recovery, concentration of affected analyte in sample is <RL <input type="checkbox"/> Other
4. CCV: 10% frequency and closing 90-110% recovery (245.1) 80-120% recovery (7470A and 7471B)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> High recovery, concentration of affected analyte in sample is <RL <input type="checkbox"/> Other
5. ICB/CCB: Run before samples, 10%, & closing Result<RL (routine) Result < 3XMDL (DoD)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> High recovery, concentration of affected analyte in sample is <RL <input type="checkbox"/> Sample results >10x blank <input type="checkbox"/> Other
6. RL-level check standard (aka CRI, LLC) 80-120% recovery (project specific)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> High recovery, concentration of affected analyte in sample is <RL <input type="checkbox"/> Sample results >10x check standard <input type="checkbox"/> Other
<b>B. Client Sample and QC Sample Results</b>					
1. Samples with results > linear range diluted and reanalyzed?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
2. Were samples diluted due to matrix interference?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
3. Were samples analyzed within hold time?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Received outside hold time <input type="checkbox"/> Received with insufficient time remaining <input type="checkbox"/> Other

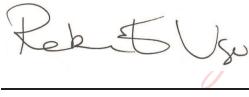
Review Items	NA	Yes	No	2 <sup>nd</sup> Rev	If No, why is data reportable? / Comments
<b>C. Preparation/Matrix QC</b>					
1. Method Blank: one per preparation batch result < RL (routine) result < ½ RL (DoD or special project)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> No analyte > RL in associated samples <input type="checkbox"/> Sample results >10x blank <input type="checkbox"/> Insufficient sample for reanalysis <input type="checkbox"/> Other
2. LCS  one per preparation batch 80-120% recovery (routine) 85-115% recovery (245.1) vendor defined limits (LCSSRM)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> LCS %R > QC limits & samples < RL <input type="checkbox"/> Insufficient sample for reanalysis <input type="checkbox"/> Other
3. MS/MSD or MS/Dup frequency:  a pair per batch (routine) a pair per 10 samples (245.1)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Insufficient sample – LCS/LCSD analyzed <input type="checkbox"/> Other
4. MS/MSD recovery & RPD:  80-120% recovery (routine) 70-130% recovery (245.1) 20% RPD (waters) 30% RPD (soils) project limits (other)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> LCS acceptable – matrix effects <input type="checkbox"/> Native analyte > 4x spike level <input type="checkbox"/> Other
5. If TCLP MS <50% and sample result 80-100% of toxicity characteristic limit, was MSA run?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
6. Serial dilution:  Required if MS/MSD fail (DoD) run at 5X dilution of parent sample ≤ 10% difference	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Matrix interference <input type="checkbox"/> Other
7. Post digestion spike:  Required if MS/MSD fail (DoD) 80-120% recovery	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Matrix interference <input type="checkbox"/> Native analyte > 4x spike level <input type="checkbox"/> Other

D. Raw Data & TALS Data Entry	Yes	No	2 <sup>nd</sup>	Comments
1. Raw Data				
a. Unused data is clearly identified	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
b. All crossed out data is initialed and dated	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
c. Out of control QC is clearly identified	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
d. Any data that has a qualifier tick is commented on with appropriate action taken	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
e. The first page of the run includes the filename, instrument, and analyst initials/signature	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
2. Run Log				
a. Unused data is clearly identified	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
b. All crossed out data is initialed and dated	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
c. Analyst initials/signature provided	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
3. TALS Samples Tab				
a. LIMS Sample IDs / Containers are correct	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
b. Method and matrix are correct	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
c. Date and time match raw data	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

## TestAmerica St. Louis

D. Raw Data & TALS Data Entry	Yes	No	2 <sup>nd</sup>	Comments
d. Dilutions are correct	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
e. Correct suffix designated (where applicable)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
4. TALS Worksheet Tab is complete and correct	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
5. TALS Reagent Tab is complete and correct	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
6. TALS QC Links Tab is correct	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
7. TALS Sample Results Tab				
a. All unused data are marked Rejected or Accepted	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
b. All reported analytes are marked Primary or Secondary	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
8. TALS Batch Information Screen documentation is complete	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
9. TALS Status set to appropriate review level	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

E. Final Report and NCMs (2 <sup>nd</sup> level review only)	Yes	No		Comments
1. Were all job/project requirements met?	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
2. Results for samples and QC correct on final report?	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
3. Are all necessary scanned documents in TALS?	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
4. NCMs reviewed for applicability, correct references to batches, grammar/typographical errors?	<input checked="" type="checkbox"/>	<input type="checkbox"/>		

2<sup>nd</sup> Reviewer:

Digitally signed by Rebecca E Vago  
 DN: cn=Rebecca E Vago, o=test  
 america, ou=metals,  
 email=rebecca.vago@testamericaninc  
 .com, c=US  
 Date: 2016.09.01 13:59:19 -05'00'

Review Date:

9-1-16

## Comments:



## HAA083116A

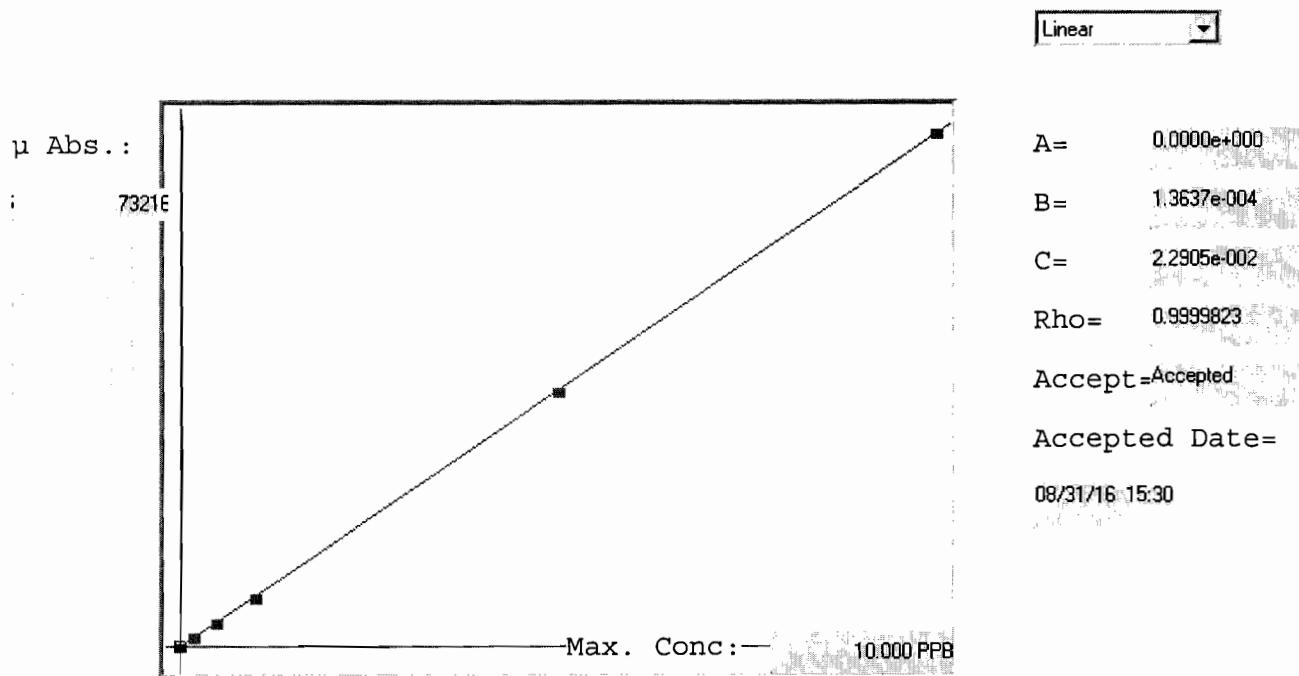
Method: Initial Method

Operator: Admin

Date of Analysis: 31 Aug 2016 15:16:51

Sample ID	Extended ID	Mean	Stats Data	Stnd Cond	Units	Chapter
160-18659-C-11-B MS		4.8368	4.7603, 4.8368, 4.9134,	-	PPB	HAA083116A
CCV		98.8% 4.9387	4.8871, 4.9391, 4.9901,	-	PPB	HAA083116A
CCB		-0.0370	-0.0366, -0.0367, -0.0378,	-	PPB	HAA083116A
160-18659-C-11-C MSD		4.8638	4.7975, 4.8759, 4.9181,	-	PPB	HAA083116A
160-18665-D-3-B		-0.0481	-0.0472, -0.0484, -0.0488,	-	PPB	HAA083116A
160-18665-D-1-B		0.0129	0.0131, 0.0130, 0.0125,	-	PPB	HAA083116A
LLC		105.1% 0.2101	0.2080, 0.2099, 0.2125,	-	PPB	HAA083116A
CCV		100.9% 5.0438	5.0193, 5.0618, 5.0503,	-	PPB	HAA083116A
CCB		-0.0351	-0.0345, -0.0353,	-	PPB	HAA083116A

Initial Method



Std ID	Conc.	Calc.	Dev.	Mean	SD or %RSD	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
CALIBRATION BLANK	0.000	0.028	0.028	40	4.497	37	38	47		
CALIBRATION 1	0.200	0.217	0.017	1421	0.7 %	1409	1422	1434		
CALIBRATION 2	0.500	0.495	-0.005	3461	0.3 %	3452	3454	3478		
CALIBRATION 3	1.000	0.960	-0.040	6873	0.5 %	6837	6868	6916		
CALIBRATION 4	5.000	4.992	-0.008	36436	0.9 %	36021	36448	36839		
CALIBRATION 5	10.000	10.008	0.008	73216	1.1 %	72211	73310	74127		

HAA083116A

## 245.1\_Prep Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 160-266559

Analyst: Shinn, Daniel A

Batch Open: 8/31/2016 10:00:00AM  
Batch End: 8/31/2016 1:30:00PM

### Preparation, Mercury

Input Sample Lab ID (Analytical Method)	SDG (Job #)	Matrix	Initial Amount	Final Amount	Due Date	Analytical TAT	Div Rank	Comments		Output Sample Lab ID
1 Calibration~Blank N/A	N/A		30 mL	30 mL	N/A	N/A	N/A			
2 CAL~1 N/A	N/A		30 mL	30 mL	N/A	N/A	N/A			
3 CAL~2 N/A	N/A		30 mL	30 mL	N/A	N/A	N/A			
4 CAL~3 N/A	N/A		30 mL	30 mL	N/A	N/A	N/A			
5 CAL~4 N/A	N/A		30 mL	30 mL	N/A	N/A	N/A			
6 CAL~5 N/A	N/A		30 mL	30 mL	N/A	N/A	N/A			
7 ICV~160-266559/7 N/A	N/A		30 mL	30 mL	N/A	N/A	N/A			
8 ICB~160-266559/8 N/A	N/A		30 mL	30 mL	N/A	N/A	N/A			
9 CCV~160-266559/9 N/A	N/A		30 mL	30 mL	N/A	N/A	N/A			
10 CCB~160-266559/10 N/A	N/A		30 mL	30 mL	N/A	N/A	N/A			

## 245.1\_Prep Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 160-266559

Analyst: Shinn, Daniel A

Batch Open: 8/31/2016 10:00:00AM  
Batch End: 8/31/2016 1:30:00PM

### attach Notes

Uncorrected Temperature	NA
Oven, Bath or Block Temperature 1	93.4
Uncorrected Temperature 2	NA
Oven, Bath or Block Temperature 2	93.7
Digestion Tube/Cup ID	229533-6417
Hood ID	HOOD 29
Hot Block ID	HOTBLOCK WC1
Thermometer ID	111815895
Temperature	NA
Lot # of Nitric Acid	954989
Lot # of hydrochloric acid	NA
Sulfuric Acid Lot Number	943743
Potassium Permanganate ID	992326
Potassium Persulfate ID	986116
Hydroxylamine Sulfate ID	986115
Stannous Chloride ID	992327
Hydroxylamine Hydrochloride ID	NA
NaCl ID	621868
Digestion Start Time	16:00
Digestion End Time	18:00

## **245.1\_Prep Analysis Sheet**

(To Accompany Samples to Instruments)

Batch Number: 160-266559

Analyst: Shinn, Daniel A

Batch Open: 8/31/2016 10:00:00AM  
Batch End: 8/31/2016 1:30:00PM

Pipette ID	MT002ANDMT005ANDMET10	
Visual ck - digestate F.V.	NA	
consistency		
pH Paper ID	NA	
Batch Comment		

Comments
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## 245.1\_Prep Analysis Sheet

(To Accompany Samples to Instruments)

Batch Number: 160-266559

Analyst: Shinn, Daniel A

Batch Open: 8/31/2016 10:00:00AM  
Batch End: 8/31/2016 1:30:00PM

### Reagent Additions Worksheet

Lab ID	Reagent Code	Amount Added	Final Amount	y	Witness
CAL 1	Hg Curve Int._00756	0.06 mL	30 mL		
CAL 2	Hg Curve Int._00756	0.15 mL	30 mL		
CAL 3	Hg Curve Int._00756	0.30 mL	30 mL		
CAL 4	Hg Curve Int._00756	1.50 mL	30 mL		
CAL 5	Hg Curve Int._00756	3.00 mL	30 mL		
ICV 160-266559/7	Hg QC Int._00736	1.50 mL	30 mL		
CCV 160-266559/9	Hg Curve Int._00756	1.50 mL	30 mL		

### Other Reagents:

Reagent	Amount/Units	Lot#:

# **ALPHA SPECTROSCOPY**

# **Method Ra-226 by AS**

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**Ra-226 by Alpha Spectroscopy by STL  
SOP**

# **Prep Batch: 266021**

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**Preparation, Digestion/ Precipitate**

# Alpha Spectroscopy Analysis Detail Report

Prep Batch: 266021

Lab ID: MB 160-266021/1-A

Client ID:

Sigma: 2

Analyzed: 09/15/16 10:20

Detector: AV221

Dil Fac: 1

Decay Corrected: No

Yield Truncated: No

Ts: 960

Analyte	MB Result	Count Unc	Total Unc	Qualifier	Unit	RL	MDC	Anly Batch	
Radium-226	0.1953	0.0942	0.0956		pCi/g	1.00	0.0787	270177	
Tracer	MB Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
At-217	3.879	0.244	0.407		pCi/g	0.0692	10.6	36.5	30 - 110

Lab ID: LCS 160-266021/2-A

Client ID:

Sigma: 2

Analyzed: 09/15/16 10:20

Detector: AV222

Dil Fac: 1

Decay Corrected: No

Yield Truncated: No

Ts: 960

Analyte	LCS Result	Count Unc	Total Unc	Qualifier	Unit	RL	MDC	Anly Batch	
Radium-226	14.07	0.873	1.47		pCi/g	1.00	0.103	270178	
Tracer	LCS Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
At-217	3.000	0.219	0.334	S	pCi/g	0.0847	10.6	28.2	30 - 110

Lab ID: 160-18504-F-1-Q DU

Client ID:

Sigma: 2

Analyzed: 09/15/16 10:19

Detector: AV225

Dil Fac: 1

Decay Corrected: No

Yield Truncated: No

Ts: 960

Analyte	DU Result	Count Unc	Total Unc	Qualifier	Unit	RL	MDC	Anly Batch	
Radium-226	0.6592	0.162	0.171		pCi/g	1.00	0.152	270180	
Tracer	DU Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
At-217	5.326	0.286	0.531		pCi/g	0.0115	10.6	50.0	30 - 110

Lab ID: 160-18521-1

Client ID: YMTFA74SE001

Sigma: 2

Analyzed: 09/15/16 10:19

Detector: AV230

Dil Fac: 1

Decay Corrected: No

Yield Truncated: No

Ts: 960

Analyte	Result	Count Unc	Total Unc	Qualifier	Unit	RL	MDC	Anly Batch	
Radium-226	0.712	0.187	0.196		pCi/g	1.00	0.190	270184	
Tracer	Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
At-217	4.53	0.261	0.462		pCi/g	0.0112	10.6	42.6	30 - 110

# Alpha Spectroscopy Analysis Detail Report

Prep Batch: 266021

Lab ID: 160-18521-2  
 Client ID: YMTFA75SE001  
 Sigma: 2

Analyzed: 09/15/16 10:19  
 Detector: AV232  
 Dil Fac: 1

Decay Corrected: No  
 Yield Truncated: No  
 Ts: 960

Analyte	Result	Count Unc	Total Unc	Qualifier	Unit	RL	MDC	Anly Batch	
Radium-226	84.4	1.87	7.33		pCi/g	1.00	0.0791	270185	
Tracer	Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
At-217	3.63	0.227	0.380		pCi/g	0.0106	10.6	34.2	30 - 110

## Quality Control Summary

Method Blank ID:	Analyte	Parent Result	Spike Added	MB Result	Qualifier	Unit	% Rec	% Rec Limits	RPD	RER	DER	RER Limit	Z Factor
MB 160-266021/1-A	Radium-226			0.1953		pCi/g							4.084670 66
Lab Control Sample ID:	Analyte	Parent Result	Spike Added	LCS Result	Qualifier	Unit	% Rec	% Rec Limits	RPD	RER	DER	RER Limit	Z Factor
LCS 160-266021/2-A	Radium-226		12.1	14.07		pCi/g	117	70 - 130					2.079628 1233
Duplicate ID:	Analyte	Parent Result	Spike Added	DU Result	Qualifier	Unit	% Rec	% Rec Limits	RPD	RER	DER	RER Limit	Z Factor
160-18504-F-1-Q DU	Radium-226	0.772		0.6592		pCi/g			16	0.31	0.88	1	

Glossary:

Ts = Count Duration, Sample

## ALPHA SPECTROSCOPY BATCH WORKSHEET

Lab Name: TestAmerica St. Louis

Job No.: 160-18521-2

SDG No.: Headworks/9720-8

Batch Number: 266021

Batch Start Date: 08/22/16 18:53

Batch Analyst: Curtright, Chelsea M

Batch Method: DPS-0

Batch End Date: 09/13/16 18:14

Lab Sample ID	Client Sample ID	Method Chain	Basis	InitialAmount	IngDecDate1	NRM-4 00001	Th-229 00021		
MB 160-266021/1		DPS-0, ST-RC-0301		0.5 g	09/12/2016 18:00		1 mL		
LCS 160-266021/2		DPS-0, ST-RC-0301		0.4999 g	09/12/2016 18:00	0.4999 g	1 mL		
160-18504-F-1-A DU		DPS-0, ST-RC-0301	T	0.4990 g	09/12/2016 18:00		1 mL		
160-18521-F-1-A	YMTFA74SE001	DPS-0, ST-RC-0301	T	0.4993 g	09/12/2016 18:00		1 mL		
160-18521-F-2-A	YMTFA75SE001	DPS-0, ST-RC-0301	T	0.5016 g	09/12/2016 18:00		1 mL		

## Batch Notes

Balance ID	0034150065
Pipette ID	RAD066
Analyst ID - Reagent Drop Witness	BME per CMC
Analyst ID - Reagent Drop	CMC
SOP Number	ST-RC-0301

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

Sample Name: MB 160-266021/1-A Type: Blank  
**Spectrum #1 Analysis #1**  
 : MB 160-266021/1-A  
 Sample Collection Date: 9/13/2016 6:21:00PM  
 Comment:

Batch Name: 266021  
 AnalysisResultsID: 177100  
 Description:

Tracer Name: Undefined  
 Tracer Activity:  
 Tracer Ref. Date:

Detector: AV221 SN: 50-117H5  
 Acquisition Start Date: 9/15/2016 10:20:00AM  
 Live Time: 960.00 min.  
 Real Time: 960.00 min.  
 Background Date: 9/1/2016 3:17:19PM  
 Bkgd Info: Sample: ICB; Det: AV221; Spectrum #1; 9/1/2016 3:17:19 PM

### Acquisition

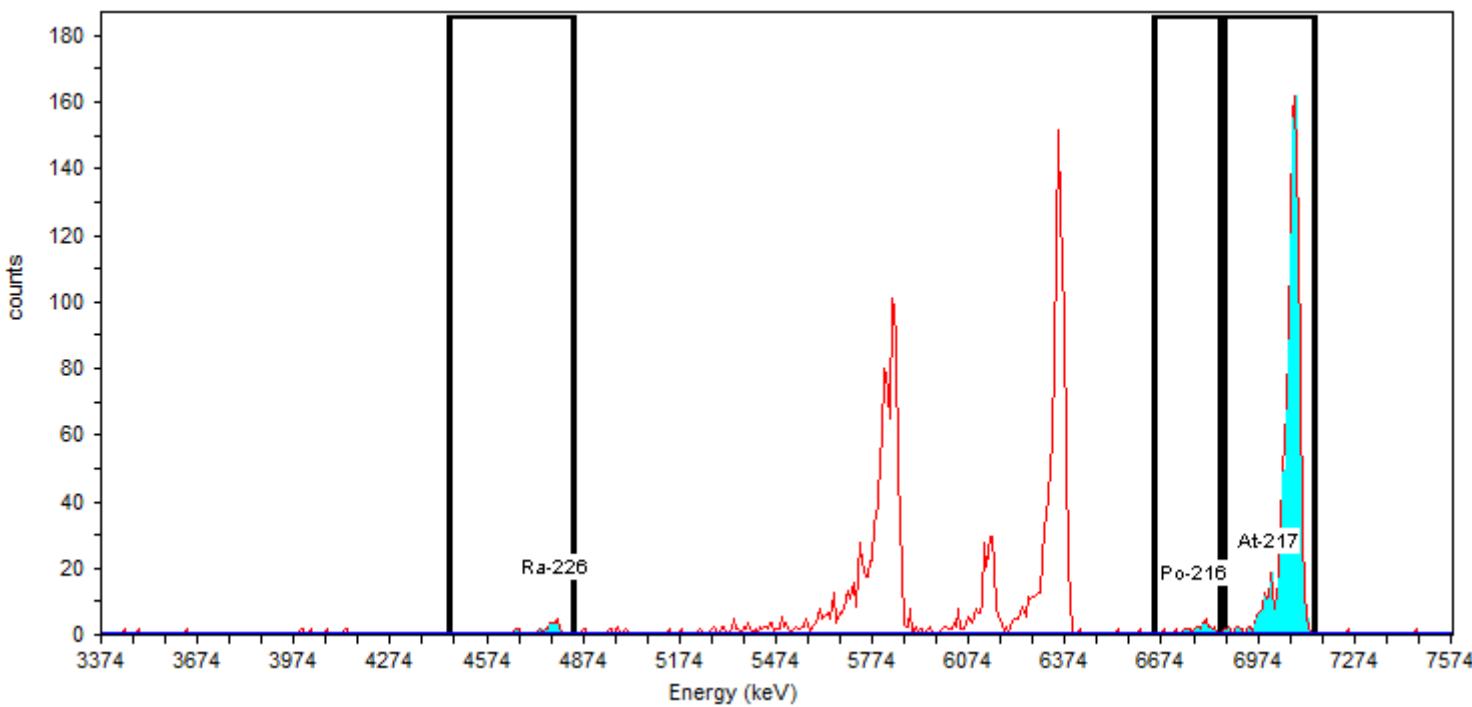
Sample Weight : 0.50 Sample Units: g  
 First Stage Dilution: N/A  
 Aliquot: N/A Aliquot Fraction: N/A  
 Dilution 2: N/A  
 Lab Preparation:

### Batch

Client Name: Undefined  
 Client Contact:  
 Analyst: 60040

### Tracer

Tracer Nuclide: External Recovery  
 Tracer Recovery: 100.00%



### General Analysis

Analysis Method: Absolute ROI Analysis, Set Name = Ra224/226

Decay Correction: 9/15/2016 10:16:08AM

MDA Constants: K $\alpha$  = 1.64, K $\beta$  = 1.64

Nuclide Library: Radium224/6

MDA Source: Background

### Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Ra-226	4783.9	4,784.5	-0.6	4455.8	4843.5	45.1	100.1	20	1.0000	19.00	7.123E-002	pCi/g
Po-216	6782.5	6,778.5	4.0	6655.7	6864.5	33.5	100.0	24	10.0000	14.00	5.254E-002	pCi/g

Alpha-Spectroscopy  
Analysis Report

TestAmerica St. Louis  
13715 Rider Trail North  
Earth City, MO 63045  
2:21:17AM 9/16/2016

Sample Name: LCS 160-266021/2-A Type: Control  
Spectrum #1 Analysis #1  
: LCS 160-266021/2-A  
Sample Collection Date: 9/13/2016 6:21:00PM  
Comment:

Batch Name: 266021  
AnalysisResultsID: 177104  
Description:

Tracer Name: Undefined  
Tracer Activity:  
Tracer Ref. Date:

Detector: AV222 SN: 50-117J2  
Acquisition Start Date: 9/15/2016 10:20:00AM  
Live Time: 960.00 min.  
Real Time: 960.00 min.  
Background Date: 9/2/2016 10:55:31AM  
Bkgd Info: Sample: ICB; Det: AV222; Spectrum #1; 9/2/2016  
10:55:31 AM

## Sample

Sample Weight : 0.50 Sample Units: g  
First Stage Dilution: N/A  
Aliquot: N/A Aliquot Fraction: N/A  
Dilution 2: N/A  
Lab Preparation:

## Batch

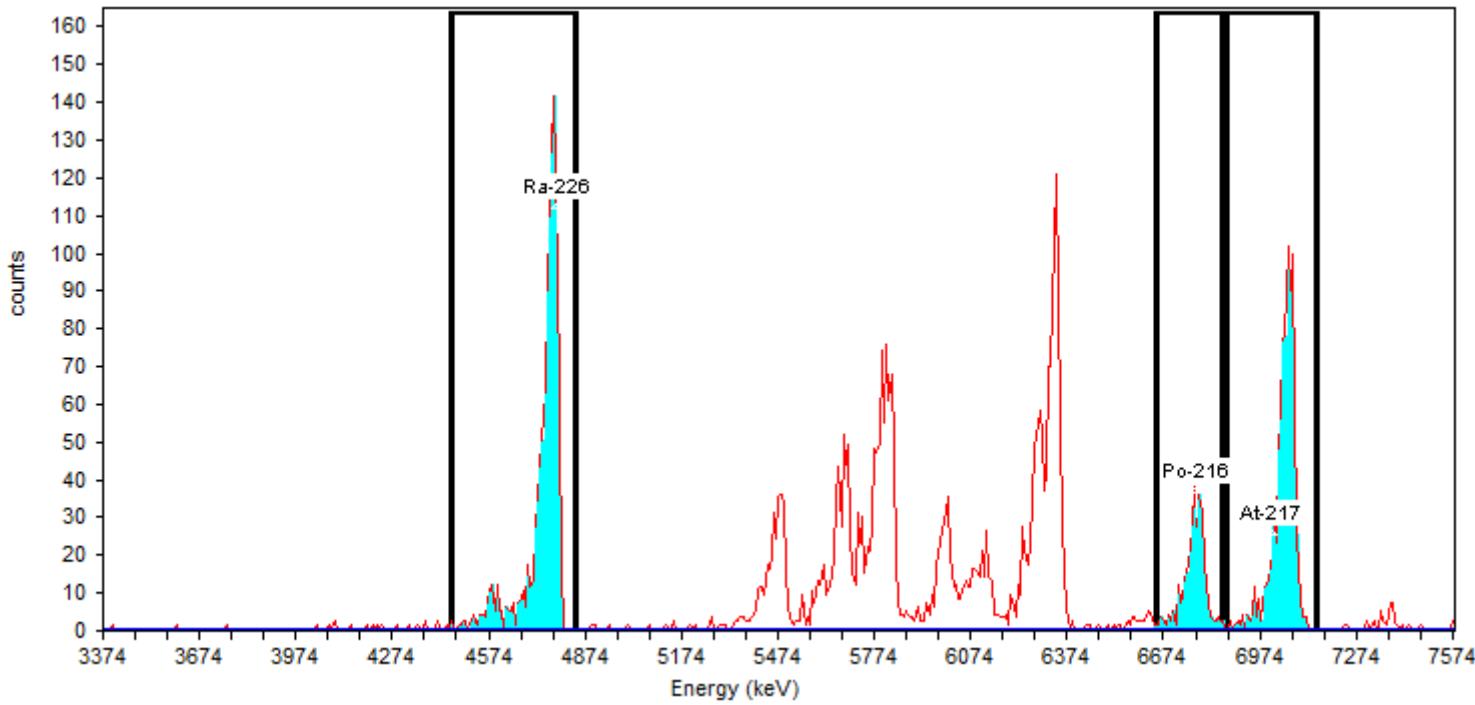
Client Name: Undefined  
Client Contact:  
Analyst: 60040

## Tracer

Tracer Nuclide: External Recovery  
Tracer Recovery: 100.00%

## Acquisition

Energy Calibration: IC-9520;AV222-20151018  
Efficiency Calibration: IC-9520;AV222-20151018  
Calibration Date: 10/18/2015 9:20:05PM  
Energy Cal: Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency: 24.61% +/- 0.35% TPU(2 sigma)



## General Analysis

Analysis Method: Absolute ROI Analysis, Set Name = Ra224/226

Decay Correction: 9/15/2016 10:16:07AM

MDA Constants: K $\alpha$  = 1.64, K $\beta$  = 1.64

Nuclide Library: Radium224/6

MDA Source: Background

## Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Ra-226	4783.9	4,784.5	-0.6	4455.8	4843.5	53.0	100.1	1042	1.0000	1041.00	3.967E+000	pCi/g
Po-216	6782.5	6,778.5	4.0	6655.7	6864.5	52.6	100.0	307	11.0000	296.00	1.129E+000	pCi/g

Sample Name: 160-18504-F-1-Q DU Type: Sample  
**Spectrum #1 Analysis #1**  
 : 160-18504-F-1-Q DU  
 Sample Collection Date: 8/4/2016 9:00:00AM  
 Comment:

Batch Name: 266021  
 AnalysisResultsID: 177102  
 Description:

Tracer Name: Undefined  
 Tracer Activity:  
 Tracer Ref. Date:

Detector: AV225 SN: 50-117J7  
 Acquisition Start Date: 9/15/2016 10:19:54AM  
 Live Time: 960.00 min.  
 Real Time: 960.00 min.  
 Background Date: 9/1/2016 3:17:20PM  
 Bkgd Info: Sample: ICB; Det: AV225; Spectrum #1; 9/1/2016  
 3:17:20 PM

### Sample

Sample Weight : 0.50 Sample Units: g  
 First Stage Dilution: N/A  
 Aliquot: N/A Aliquot Fraction: N/A  
 Dilution 2: N/A  
 Lab Preparation:

### Batch

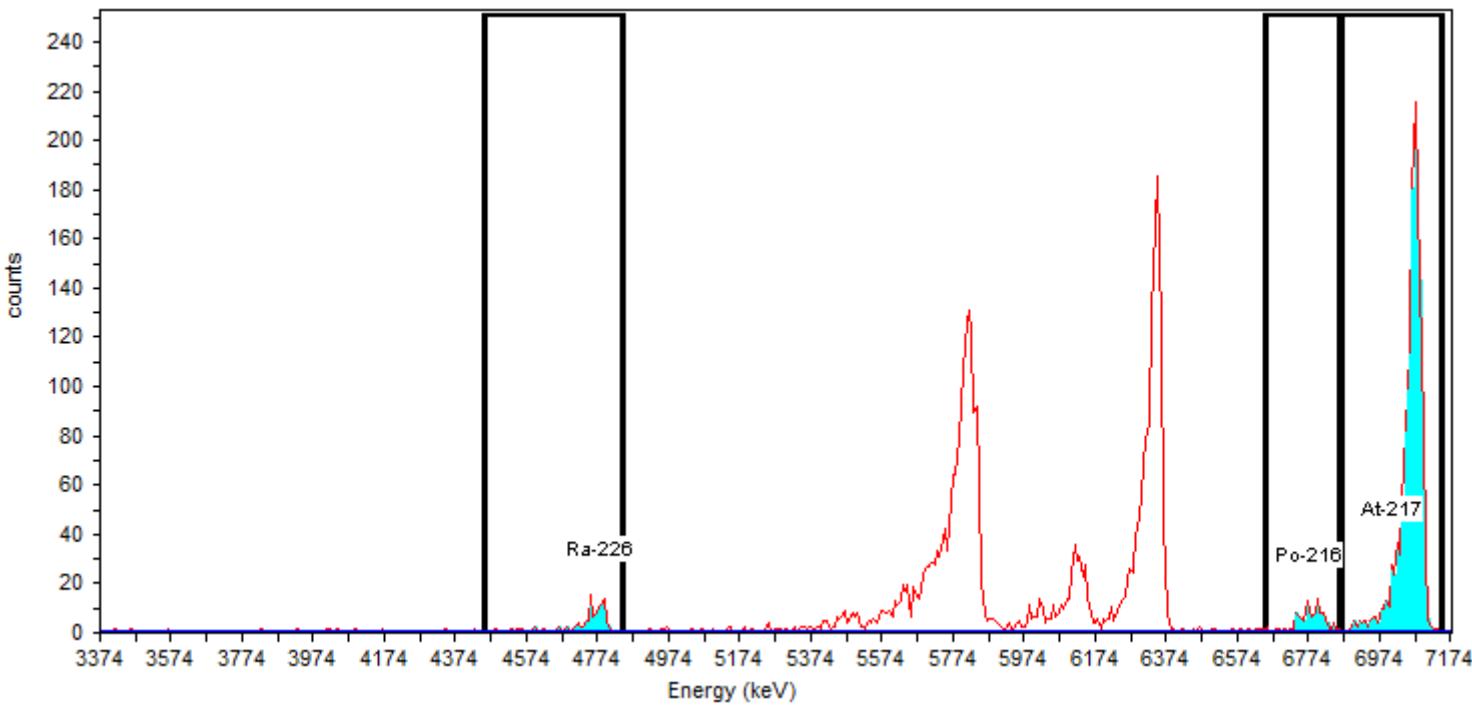
Client Name: Undefined  
 Client Contact:  
 Analyst: 60040

### Tracer

Tracer Nuclide: External Recovery  
 Tracer Recovery: 100.00%

### Acquisition

Energy Calibration: IC-9794;AV225-20151018  
 Efficiency Calibration: IC-9794;AV225-20151018  
 Calibration Date: 10/18/2015 9:20:17PM  
 Energy Cal: Gain = 7.4575 keV / Ch  
 Offset = 3,366.95 keV  
 Quadratic = 0.0000 keV / Ch<sup>2</sup>  
 Efficiency: 24.52% +/- 0.31% TPU(2 sigma)



### General Analysis

Analysis Method: Absolute ROI Analysis, Set Name = Ra224/226

Decay Correction: 9/15/2016 10:16:06AM

MDA Constants: K $\alpha$  = 1.64, K $\beta$  = 1.64

Nuclide Library: Radium224/6

MDA Source: Background

### Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Ra-226	4783.9	4,784.5	-0.6	4455.8	4843.5	67.9	100.1	99	13.0000	86.00	3.294E-001	pCi/g
Po-216	6782.5	6,778.5	4.0	6655.7	6864.5	83.6	100.0	103	0.0000	103.00	3.949E-001	pCi/g

Sample Name: 160-18521-F-1-K Type: Sample  
**Spectrum #1 Analysis #1**  
 : 160-18521-F-1-K  
 Sample Collection Date: 8/5/2016 7:50:00AM  
 Comment:

Batch Name: 266021  
 AnalysisResultsID: 177109  
 Description:

Tracer Name: Undefined  
 Tracer Activity:  
 Tracer Ref. Date:

Detector: AV230 SN: 49-045J5  
 Acquisition Start Date: 9/15/2016 10:19:56AM  
 Live Time: 960.00 min.  
 Real Time: 960.01 min.  
 Background Date: 9/1/2016 3:17:21PM  
 Bkgd Info: Sample: ICB;AV230; Det: AV230; Spectrum #1; 9/1/2016 3:17:21 PM

### Sample

Sample Weight : 0.50 Sample Units: g  
 First Stage Dilution: N/A  
 Aliquot: N/A Aliquot Fraction: N/A  
 Dilution 2: N/A  
 Lab Preparation:

### Batch

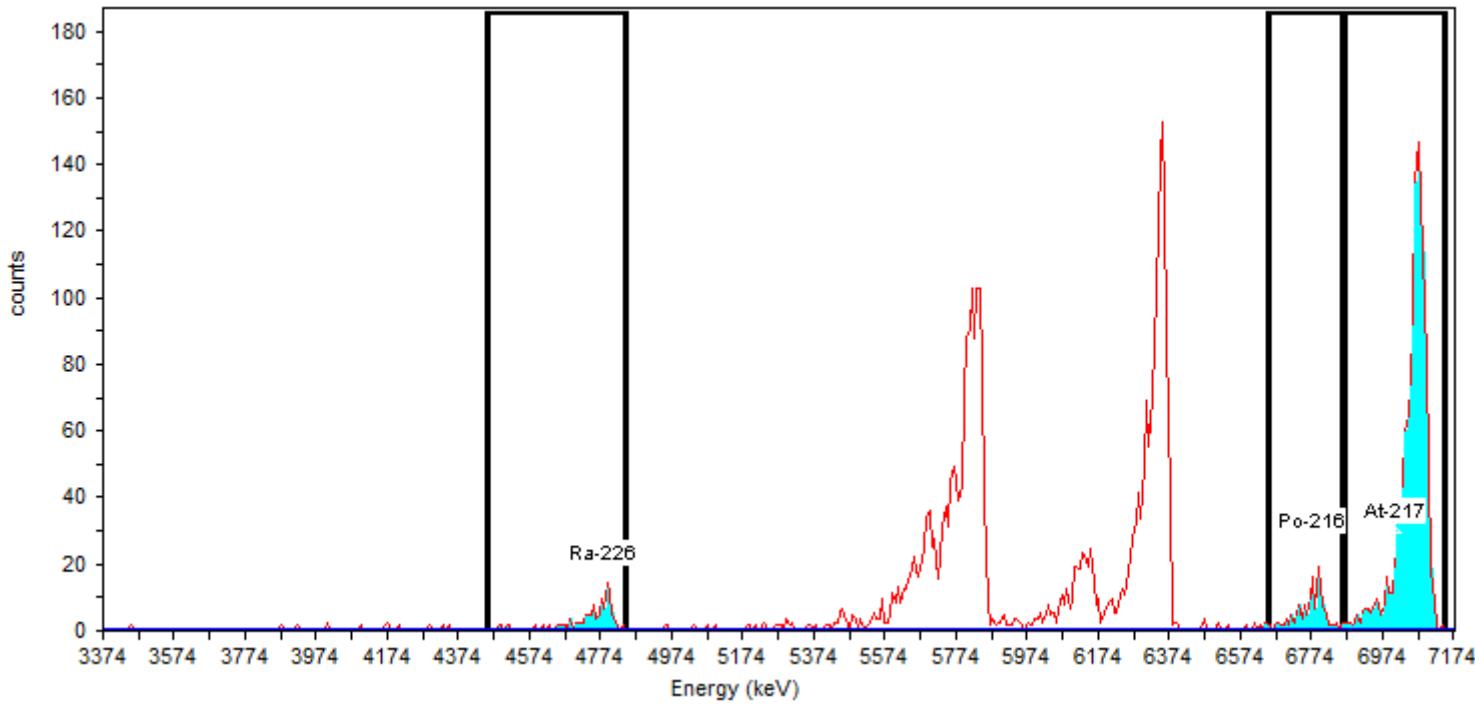
Client Name: Undefined  
 Client Contact:  
 Analyst: 60040

### Tracer

Tracer Nuclide: External Recovery  
 Tracer Recovery: 100.00%

### Acquisition

Energy Calibration: IC-9886;AV230-20151018  
 Efficiency Calibration: IC-9886;AV230-20151018  
 Calibration Date: 10/18/2015 9:20:40PM  
 Energy Cal: Gain = 7.4575 keV / Ch  
 Offset = 3,366.95 keV  
 Quadratic = 0.0000 keV / Ch<sup>2</sup>  
 Efficiency: 25.09% +/- 0.34% TPU(2 sigma)



### General Analysis

Analysis Method: Absolute ROI Analysis, Set Name = Ra224/226

Decay Correction: 9/15/2016 10:16:07AM

MDA Constants: K $\alpha$  = 1.64, K $\beta$  = 1.64

Nuclide Library: Radium224/6

MDA Source: Background

### Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Ra-226	4783.9	4,784.5	-0.6	4455.8	4843.5	49.3	100.1	97	16.0000	81.00	3.031E-001	pCi/g
Po-216	6782.5	6,778.5	4.0	6655.7	6864.5	42.8	100.0	125	1.0000	124.00	4.644E-001	pCi/g

Sample Name: 160-18521-F-2-J Type: Sample  
**Spectrum #1 Analysis #1**  
 : 160-18521-F-2-J  
 Sample Collection Date: 8/5/2016 9:25:00AM  
 Comment:

Batch Name: 266021  
 AnalysisResultsID: 177106  
 Description:

Tracer Name: Undefined  
 Tracer Activity:  
 Tracer Ref. Date:

Detector: AV232 SN: 46-033p2  
 Acquisition Start Date: 9/15/2016 10:19:56AM  
 Live Time: 960.00 min.  
 Real Time: 960.02 min.  
 Background Date: 9/1/2016 3:17:21PM  
 Bkgd Info: Sample: ICB; Det: AV232; Spectrum #1; 9/1/2016  
 3:17:21 PM

### Sample

Sample Weight : 0.50 Sample Units: g  
 First Stage Dilution: N/A  
 Aliquot: N/A Aliquot Fraction: N/A  
 Dilution 2: N/A  
 Lab Preparation:

### Batch

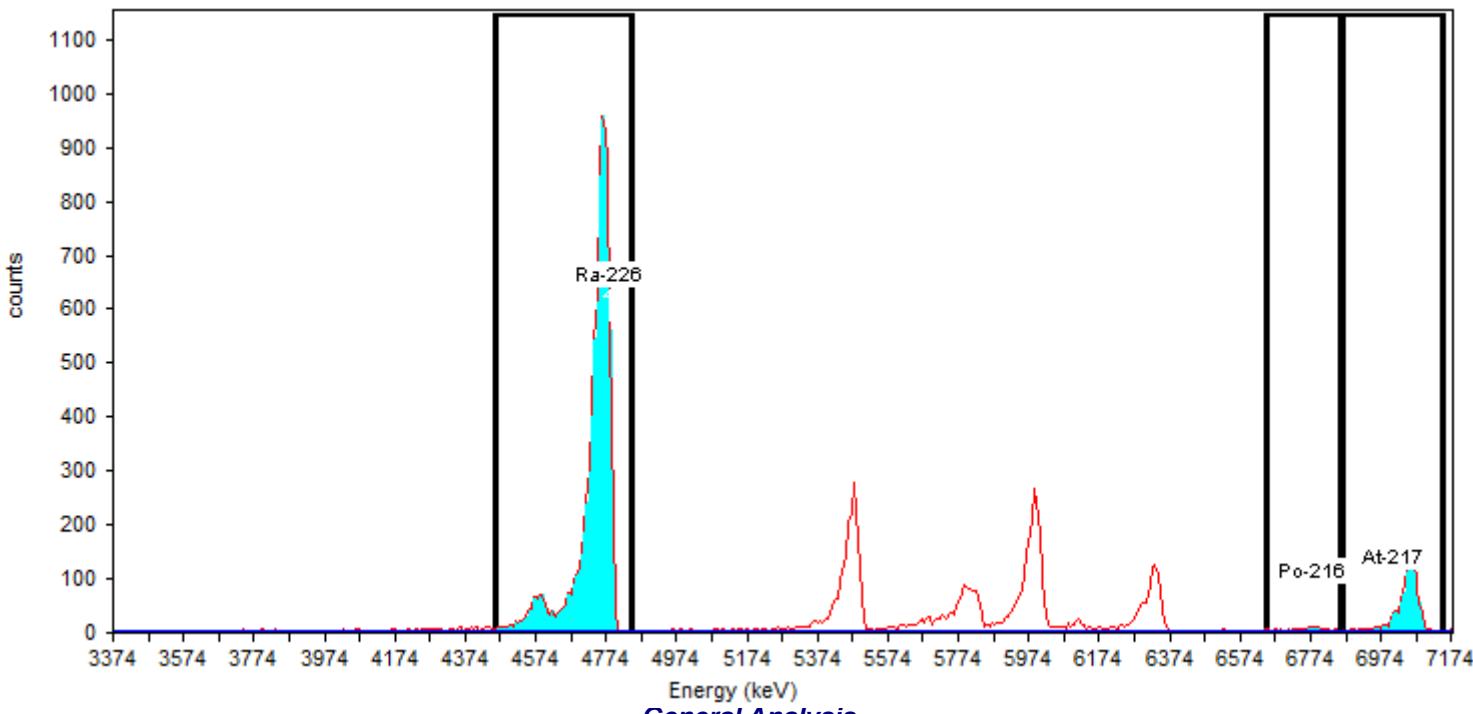
Client Name: Undefined  
 Client Contact:  
 Analyst: 60040

### Tracer

Tracer Nuclide: External Recovery  
 Tracer Recovery: 100.00%

### Acquisition

Energy Calibration: IC-8874;AV232-20151018  
 Efficiency Calibration: IC-8874;AV232-20151018  
 Calibration Date: 10/19/2015 4:11:30PM  
 Energy Cal: Gain = 7.4575 keV / Ch  
 Offset = 3,366.95 keV  
 Quadratic = 0.0000 keV / Ch<sup>2</sup>  
 Efficiency: 26.40% +/- 0.38% TPU(2 sigma)



### General Analysis

Analysis Method: Absolute ROI Analysis, Set Name = Ra224/226

Decay Correction: 9/15/2016 10:16:07AM

MDA Constants: K $\alpha$  = 1.64, K $\beta$  = 1.64

Nuclide Library: Radium224/6

MDA Source: Background

### Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Ra-226	4783.9	4,784.5	-0.6	4455.8	4843.5	55.2	100.1	8170	1.0000	8169.00	2.892E+001	pCi/g
Po-216	6782.5	6,778.5	4.0	6655.7	6864.5	56.5	100.0	85	3.0000	82.00	2.906E-001	pCi/g

# **Daily Checks**

## Alpha Spectroscopy Daily Pulser Check

**Analysis Date:** 09/15/16

Detector	Analysis Date	Gross Counts			FWHM (keV)			Pulser Center			Energy (keV)		
		Result	Criteria	P/F	Result	Criteria	P/F	Result	Criteria	P/F	Result	Criteria	P/F
AV221	09/15/16 09:29	5728	5547.6-6131.6	Pass	13.3	10-20	Pass	222.9	218.4-228.4	Pass	5029	4993.3-5073.3	Pass
AV222	09/15/16 09:29	5875	5709.0-6309.9	Pass	12.9	10-20	Pass	223.0	219.0-229.0	Pass	5030	4997.7-5077.7	Pass
AV225	09/15/16 09:29	5872	5675.0-6272.4	Pass	12.7	10-20	Pass	224.0	219.0-229.0	Pass	5038	4997.7-5077.7	Pass
AV230	09/15/16 09:29	5877	5588.1-6176.3	Pass	12.8	10-20	Pass	222.0	217.0-227.0	Pass	5023	4982.6-5062.6	Pass
AV232	09/15/16 09:29	5951	5696.2-6295.8	Pass	17.1	10-20	Pass	223.2	217.5-227.5	Pass	5031	4986.3-5066.3	Pass

## Alpha-Spectroscopy Pulser Report

TestAmerica St. Louis  
13715 Rider Trail North  
Earth City, MO 63045

9:35:15AM 9/15/2016

Sample Name: Pulser;AV221

**Sample**

Spectrum #8 Analysis #1

Comment:

**Batch**

Batch Name: August2016c

Description:

**Acquisition**

Detector: AV221 , SN: 50-117H5

Energy Calibration Equation:

Acquisition Start Date: 9/15/2016 9:29:31AM

Gain = 7.4575 keV / Ch

Live Time: 1.00 min.

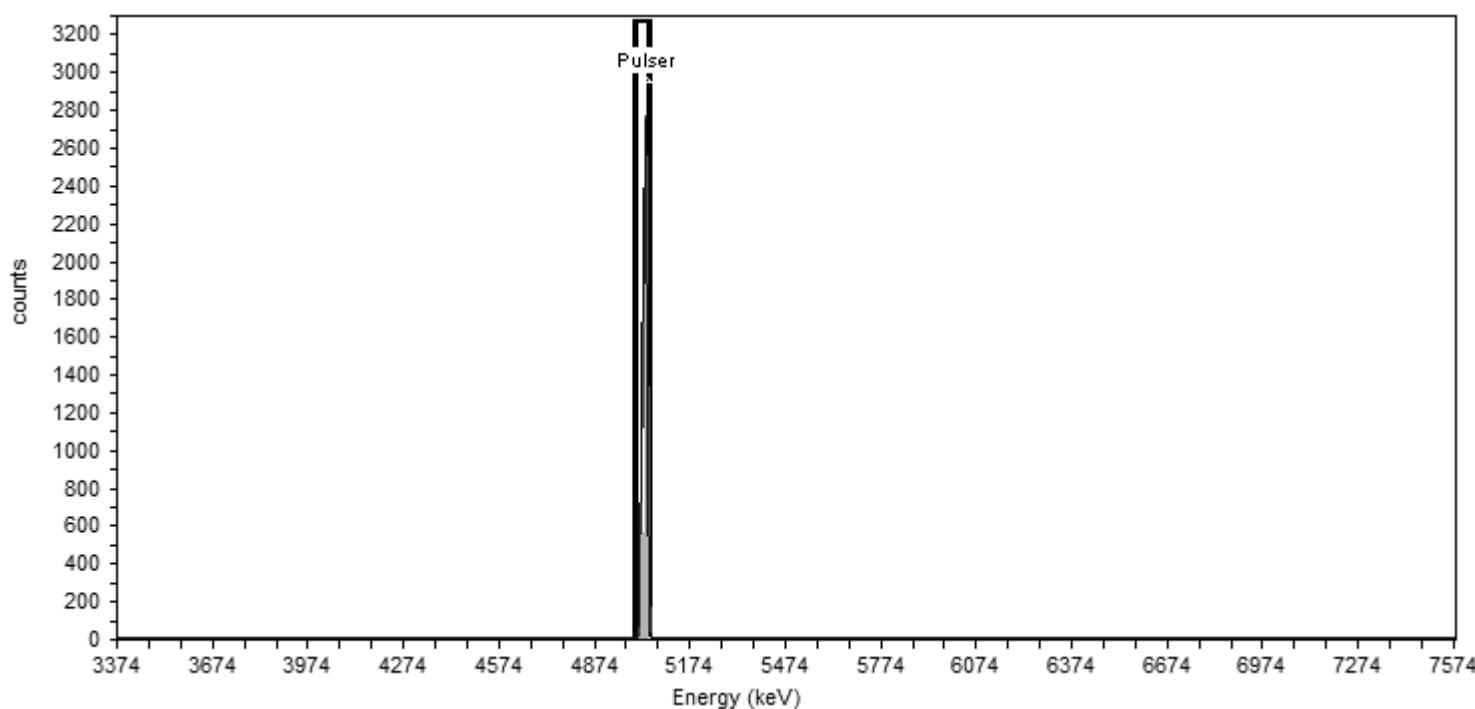
Offset = 3,366.95 keV

Real Time: 1.01 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Calibration Name: IC-8877;AV221-20151018

Calibration Date: 10/18/2015 9:20:01PM

**General Analysis**

Analysis Method: Peak Fit Analysis

**Nuclide Summary (Peak Search)**

Nuclide	Peak Energy keV	Start Energy keV	End Energy keV	FWHM keV	Fit Area	Gross Counts
Pulser	5029.419	5006.720	5052.119	13.34	5,290.44	5,728.13

## Alpha-Spectroscopy Pulser Report

TestAmerica St. Louis  
13715 Rider Trail North  
Earth City, MO 63045

9:35:18AM 9/15/2016

Sample Name: Pulser;AV222

**Sample**

Spectrum #8 Analysis #1

Comment:

**Batch**

Batch Name: August2016c

Description:

**Acquisition**

Detector: AV222 , SN: 50-117J2

Energy Calibration Equation:

Acquisition Start Date: 9/15/2016 9:29:31AM

Gain = 7.4575 keV / Ch

Live Time: 1.00 min.

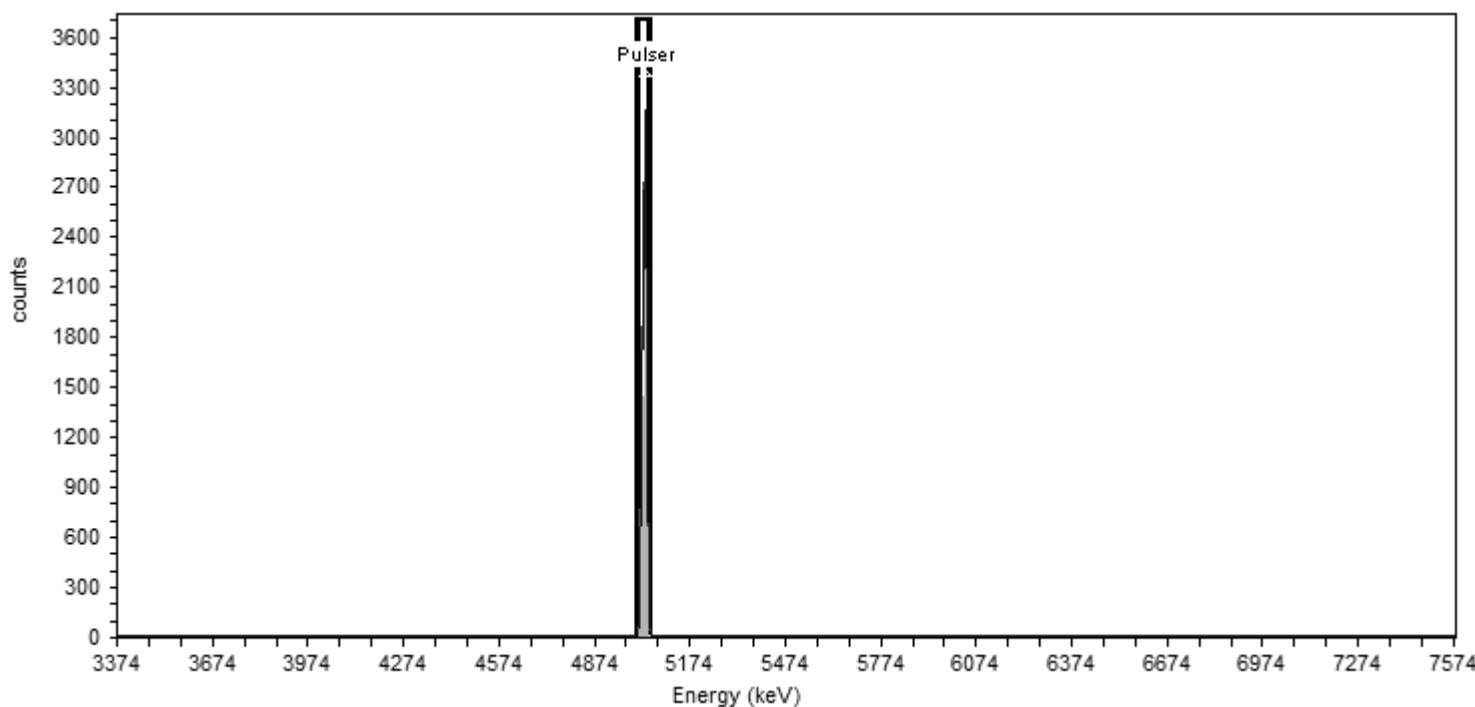
Offset = 3,366.95 keV

Real Time: 1.00 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Calibration Name: IC-9520;AV222-20151018

Calibration Date: 10/18/2015 9:20:05PM

**General Analysis**

Analysis Method: Peak Fit Analysis

**Nuclide Summary (Peak Search)**

Nuclide	Peak Energy keV	Start Energy keV	End Energy keV	FWHM keV	Fit Area	Gross Counts
Pulser	5030.042	5008.030	5052.053	12.93	5,873.38	5,874.88

## Alpha-Spectroscopy Pulser Report

TestAmerica St. Louis  
13715 Rider Trail North  
Earth City, MO 63045

9:35:12AM 9/15/2016

Sample Name: Pulser;AV225

**Sample**

Spectrum #8 Analysis #1

Comment:

**Batch**

Batch Name: August2016c

Description:

**Acquisition**

Detector: AV225 , SN: 50-117J7

Energy Calibration Equation:

Acquisition Start Date: 9/15/2016 9:29:32AM

Gain = 7.4575 keV / Ch

Live Time: 1.00 min.

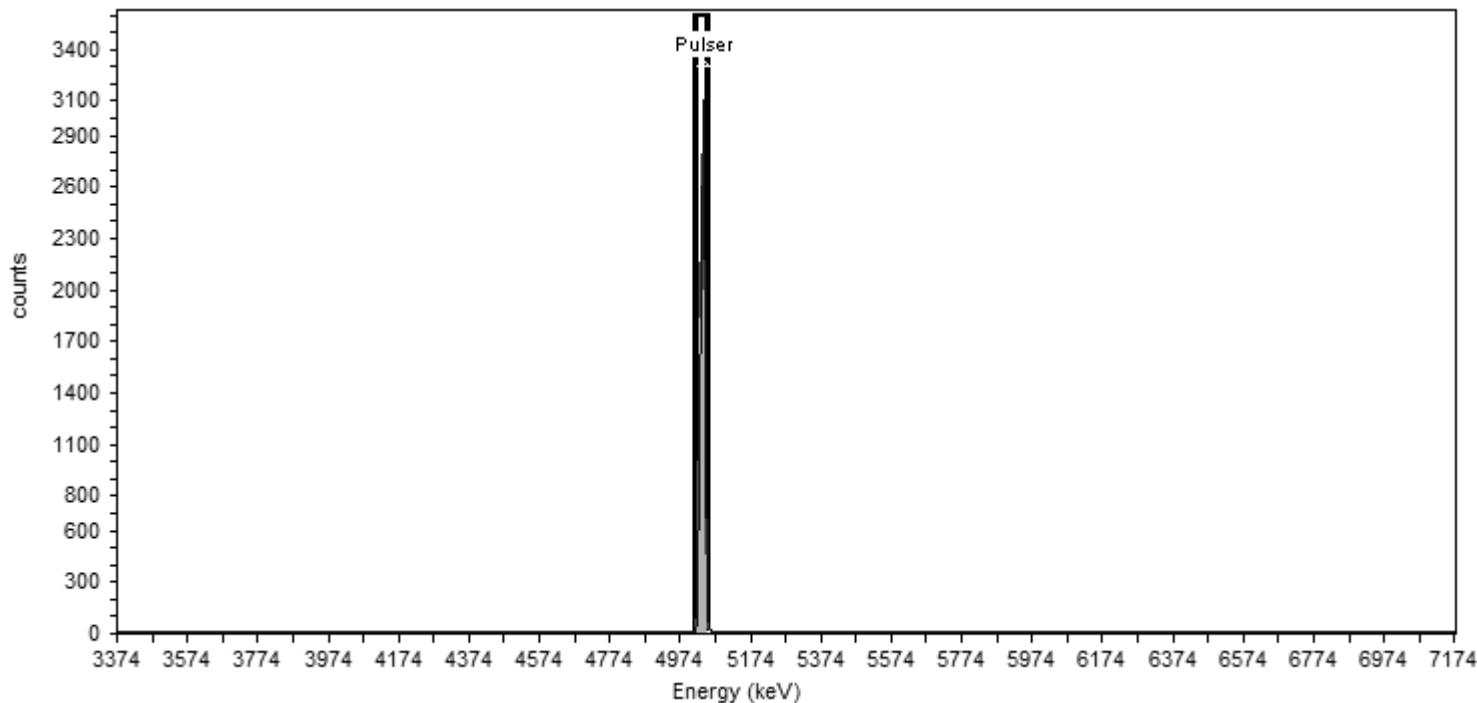
Offset = 3,366.95 keV

Real Time: 1.00 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Calibration Name: IC-9794;AV225-20151018

Calibration Date: 10/18/2015 9:20:17PM

**General Analysis**

Analysis Method: Peak Fit Analysis

**Nuclide Summary (Peak Search)**

Nuclide	Peak Energy keV	Start Energy keV	End Energy keV	FWHM keV	Fit Area	Gross Counts
Pulser	5037.654	5016.108	5059.200	12.66	5,635.10	5,871.85

## Alpha-Spectroscopy Pulser Report

TestAmerica St. Louis  
13715 Rider Trail North  
Earth City, MO 63045

9:33:56AM 9/15/2016

Sample Name: Pulser;AV230

**Sample**

Spectrum #8 Analysis #1

Comment:

**Batch**

Batch Name: August2016c

Description:

**Acquisition**

Detector: AV230 , SN: 49-045J5

Energy Calibration Equation:

Acquisition Start Date: 9/15/2016 9:29:32AM

Gain = 7.4575 keV / Ch

Live Time: 1.00 min.

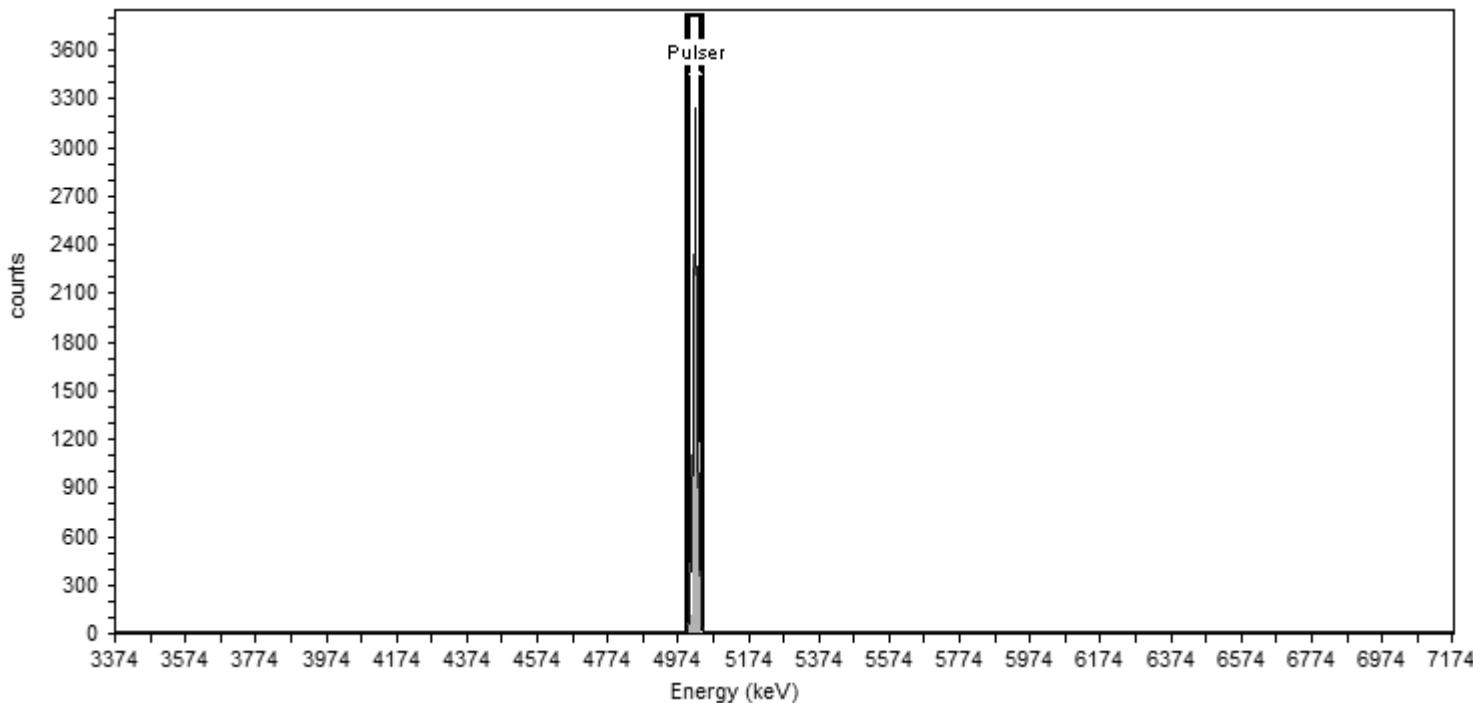
Offset = 3,366.95 keV

Real Time: 1.00 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Calibration Name: IC-9886;AV230-20151018

Calibration Date: 10/18/2015 9:20:40PM

**General Analysis**

Analysis Method: Peak Fit Analysis

**Nuclide Summary (Peak Search)**

Nuclide	Peak Energy keV	Start Energy keV	End Energy keV	FWHM keV	Fit Area	Gross Counts
Pulser	5022.596	5000.794	5044.397	12.81	5,960.29	5,876.93

## Alpha-Spectroscopy Pulser Report

TestAmerica St. Louis  
13715 Rider Trail North  
Earth City, MO 63045

9:33:53AM 9/15/2016

Sample Name: Pulser;AV232

**Sample**

Spectrum #8 Analysis #1

Comment:

**Batch**

Batch Name: August2016c

Description:

**Acquisition**

Detector: AV232 , SN: 46-033p2

Energy Calibration Equation:

Acquisition Start Date: 9/15/2016 9:29:33AM

Gain = 7.4575 keV / Ch

Live Time: 1.00 min.

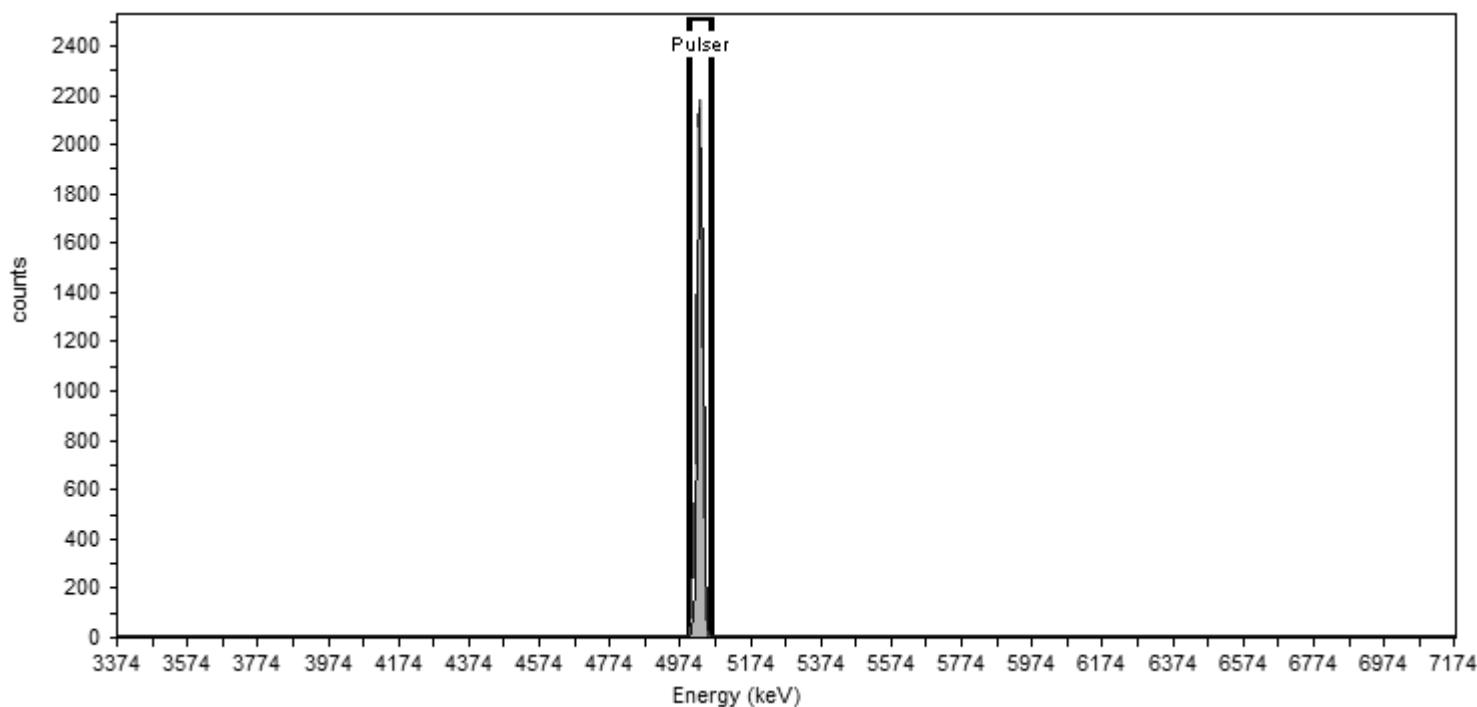
Offset = 3,366.95 keV

Real Time: 1.00 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Calibration Name: IC-8874;AV232-20151018

Calibration Date: 10/19/2015 4:11:30PM

**General Analysis**

Analysis Method: Peak Fit Analysis

**Nuclide Summary (Peak Search)**

Nuclide	Peak Energy keV	Start Energy keV	End Energy keV	FWHM keV	Fit Area	Gross Counts
Pulser	5031.175	5002.114	5060.237	17.07	5,332.59	5,950.95

# **Initial Calibrations**

### Calibration

Sample Name: IC-8877;AV221-20151018  
Description:  
Detector: AV221

Analyst: 60040

Analysis Date: 10/18/2015 9:20:01PM  
Calibration Type: Energy And Efficiency

### Source Info

Certificate ID: 82236-334  
Prepared by: Analytics  
Description:

Certification Date: 6/2/2010 12:00:00PM

### Acquisition

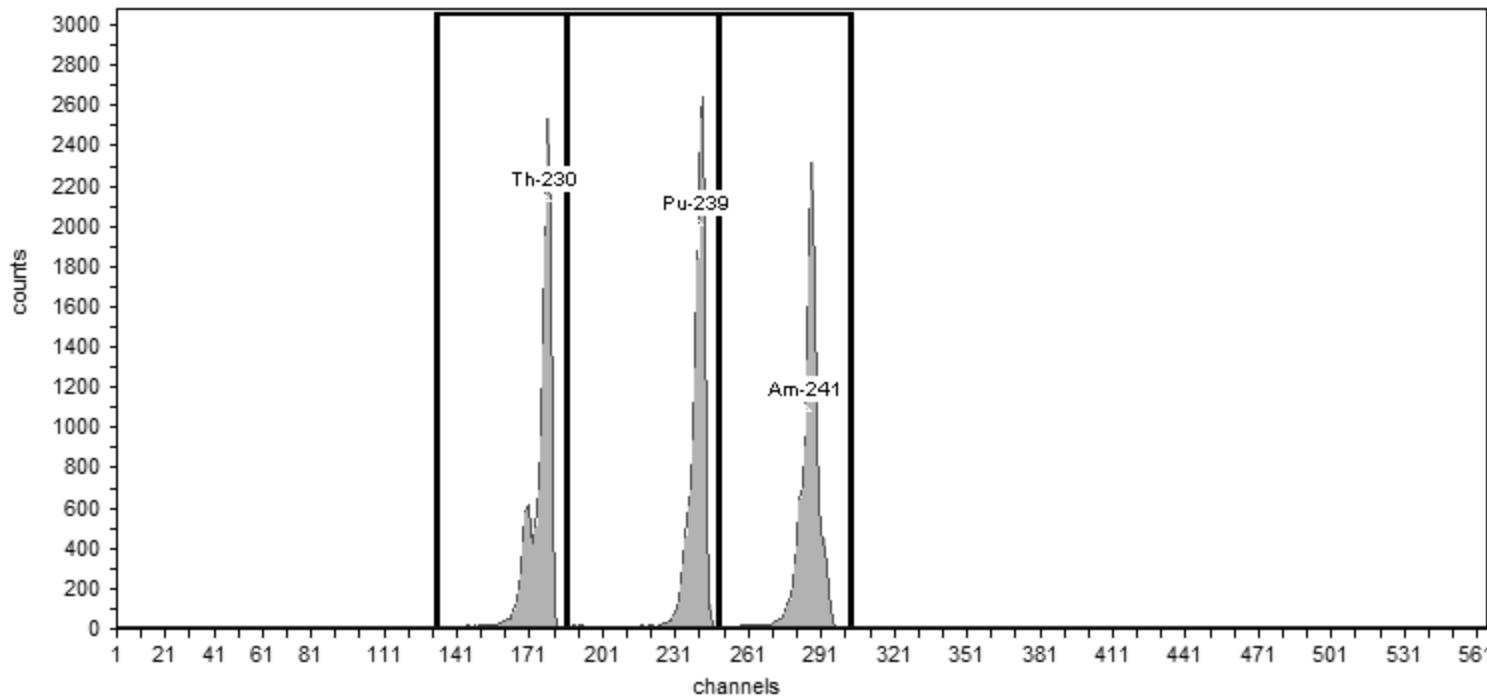
Detector: AV221 , SN: 50-117H5  
Acquisition Start Date: 10/18/2015 6:58:18PM  
Live Time: 140.00 min.  
Real Time: 140.01 min.

Energy Calibration Equation:  
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: IC-8877;AV221-20151018

Efficiency: 25.01% +/- 0.30% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: Yes  
Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	29.07	14,382.00	102.73
Pu-239	240	5,155.40	186	249	32.73	14,724.00	105.17
Am-241	284	5,485.70	249	303	31.22	14,298.00	102.13

**Calibration**

Sample Name: IC-9520;AV222-20151018  
Description:  
Detector: AV222

Analyst: 60040

Analysis Date: 10/18/2015 9:20:05PM  
Calibration Type: Energy And Efficiency

**Source Info**

Certificate ID: 82237-334  
Prepared by: Analytics  
Description:

Certification Date: 6/1/2010 12:00:00PM

**Acquisition**

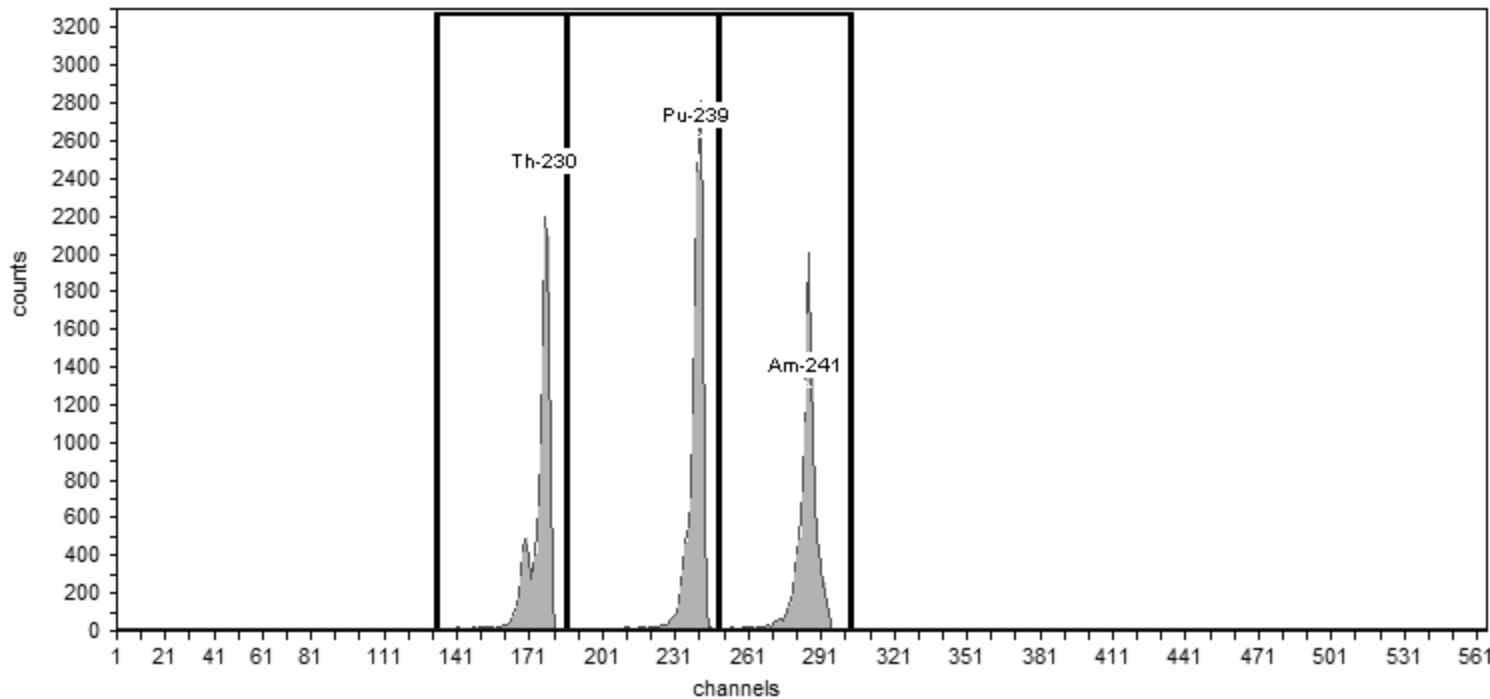
Detector: AV222 , SN: 50-117J2  
Acquisition Start Date: 10/18/2015 6:58:28PM  
Live Time: 140.00 min.  
Real Time: 140.01 min.

Energy Calibration Equation:  
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: IC-9520;AV222-20151018

Efficiency: 24.61% +/- 0.35% TPU(2 sigma)



**General Analysis**

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: Yes  
Shelf: 0

**Nuclide Activity Summary**

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	27.18	11,747.00	83.91
Pu-239	240	5,155.40	186	249	29.69	13,755.00	98.25
Am-241	284	5,485.70	249	303	28.65	11,378.00	81.27

### Calibration

Sample Name: IC-9794;AV225-20151018

Analyst: 60040

Description:

Analysis Date: 10/18/2015 9:20:17PM

Detector: AV225

Calibration Type: Energy And Efficiency

Certificate ID: 82242-334

Prepared by: Analytics

Description:

### Source Info

Certification Date: 6/8/2010 12:00:00PM

Detector: AV225 , SN: 50-117J7

Energy Calibration Equation:

Acquisition Start Date: 10/18/2015 6:59:05PM

Gain = 7.4575 keV / Ch

Live Time: 140.00 min.

Offset = 3,366.95 keV

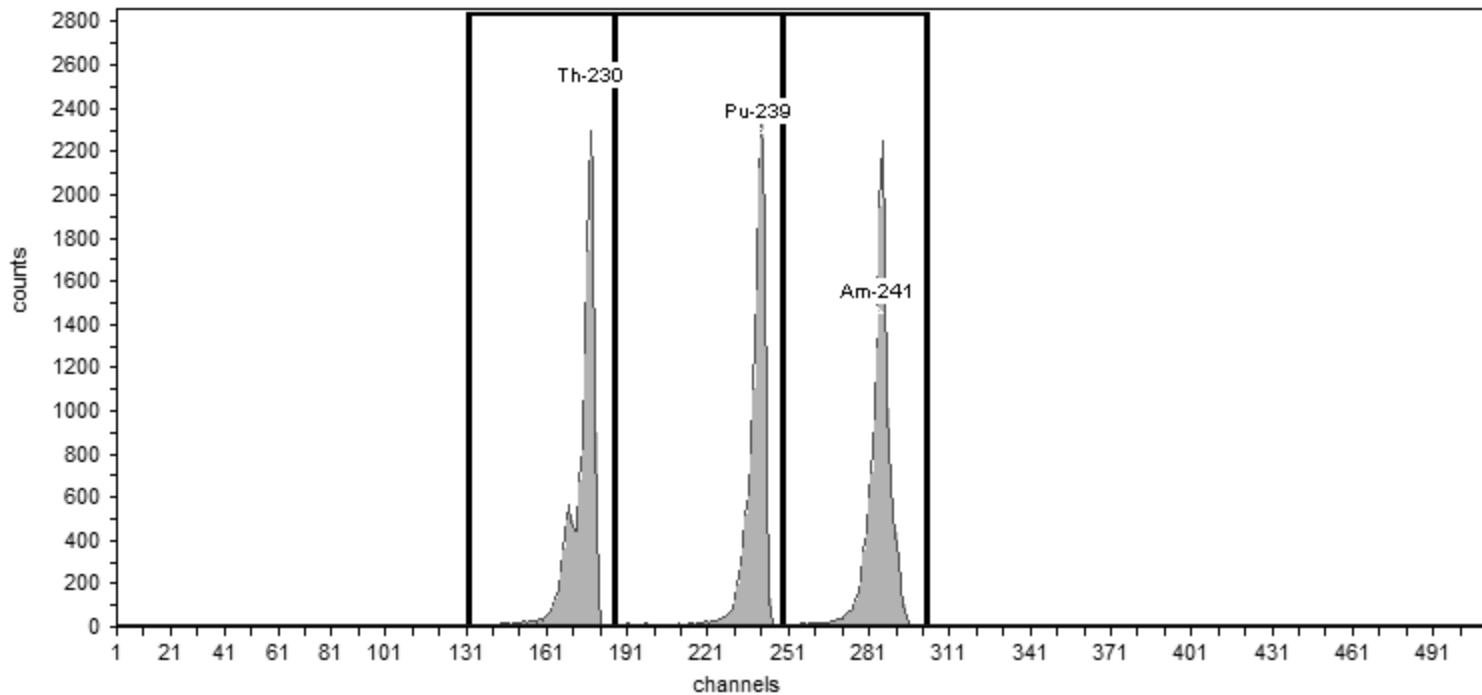
Real Time: 140.01 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: IC-9794;AV225-20151018

Efficiency: 24.52% +/- 0.31% TPU(2 sigma)

### Acquisition



### General Analysis

Method: Manual (ROI)

Initial Calibration: Yes

Algorithm: Linear

Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	30.15	13,669.00	97.64
Pu-239	240	5,155.40	186	249	32.60	13,266.00	94.76
Am-241	284	5,485.70	249	303	32.29	14,454.00	103.24

### Calibration

Sample Name: IC-9886;AV230-20151018  
Description:  
Detector: AV230

Analyst: 60040

Analysis Date: 10/18/2015 9:20:40PM  
Calibration Type: Energy And Efficiency

### Source Info

Certificate ID: 82247-334  
Prepared by: Analytics  
Description:

Certification Date: 6/10/2010 12:00:00PM

### Acquisition

Detector: AV230 , SN: 49-045J5  
Acquisition Start Date: 10/18/2015 7:00:06PM  
Live Time: 140.00 min.  
Real Time: 140.01 min.  
Efficiency Calibration Name: IC-9886;AV230-20151018

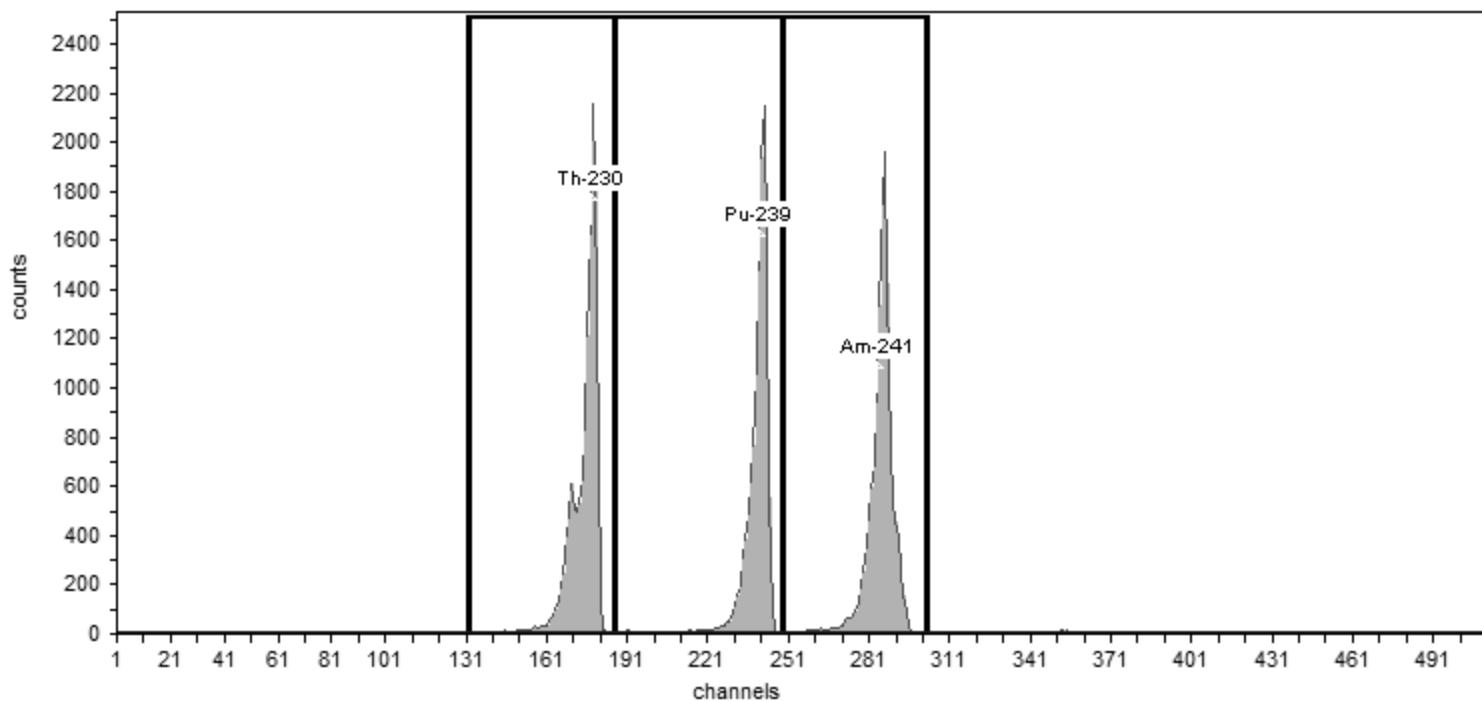
Energy Calibration Equation:

Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency: 25.09% +/- 0.34% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: Yes  
Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	30.02	13,112.00	93.66
Pu-239	240	5,155.40	186	249	32.97	12,156.00	86.83
Am-241	284	5,485.70	249	303	33.83	13,181.00	94.15

---

**Calibration**

Sample Name: IC-8874;AV232-20151018

Analyst: 60040

Description:

Analysis Date: 10/19/2015 4:11:30PM

Detector: AV232

Calibration Type: Energy And Efficiency

Certificate ID: 82233-334

---

**Source Info**

Certification Date: 6/3/2010 12:00:00PM

Prepared by: Analytics

Description:

---

**Acquisition**

Detector: AV232 , SN: 46-033p2

Energy Calibration Equation:

Acquisition Start Date: 10/18/2015 9:31:35PM

Gain = 7.4575 keV / Ch

Live Time: 140.00 min.

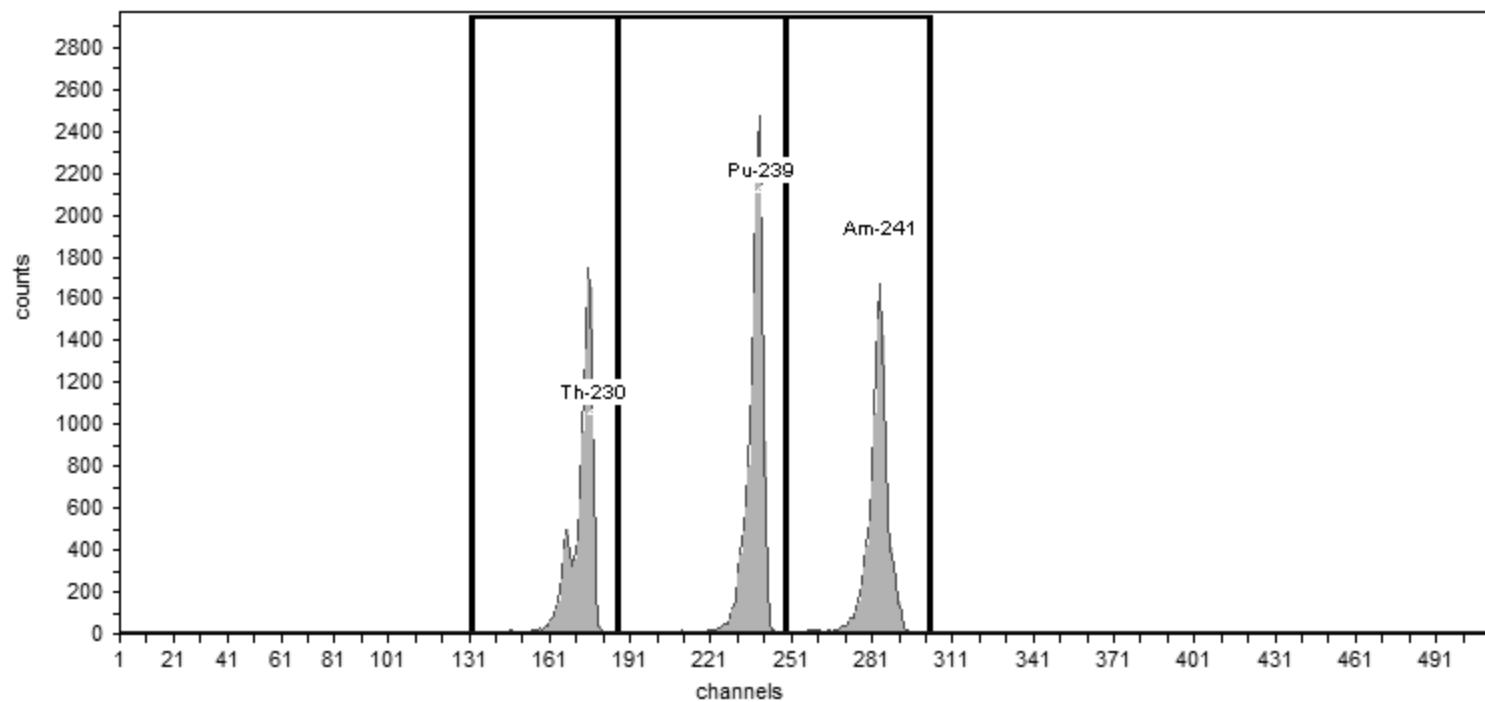
Offset = 3,366.95 keV

Real Time: 140.01 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: IC-8874;AV232-20151018

Efficiency: 26.40% +/- 0.38% TPU(2 sigma)



---

**General Analysis**

Method: Manual (ROI)

Initial Calibration: Yes

Algorithm: Linear

Shelf: 0

---

**Nuclide Activity Summary**

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	32.16	10,743.00	76.74
Pu-239	240	5,155.40	186	249	34.08	13,748.00	98.20
Am-241	284	5,485.70	249	303	35.79	11,168.00	79.77

# **Initial Calibration Verifications**

# Alpha Spectroscopy Calibration Summary

## Detector: AV221

Lab Sample ID	Analysis Date	Reagent ID	Efficiency	Efficiency Limits	Efficiency Recovery	Recovery Limits
IC 160-223517/1	10/18/15 18:58	82236-334_00001	0.2501			
ICV 160-223636/1	11/01/15 19:17	82246-334_00001	0.2527		101.1	
CCV 160-268361/1	09/06/16 11:26	82236-334_00001	0.2498		99.9	

## Detector: AV222

Lab Sample ID	Analysis Date	Reagent ID	Efficiency	Efficiency Limits	Efficiency Recovery	Recovery Limits
IC 160-223518/1	10/18/15 18:58	82237-334_00003	0.2461			
ICV 160-223637/1	11/01/15 19:18	82242-334_00001	0.2452		99.6	
CCV 160-268362/1	09/06/16 10:08	82237-334_00003	0.2424		98.5	

## Detector: AV225

Lab Sample ID	Analysis Date	Reagent ID	Efficiency	Efficiency Limits	Efficiency Recovery	Recovery Limits
IC 160-223521/1	10/18/15 18:59	82242-334_00001	0.2452			
ICV 160-223640/1	11/01/15 19:18	82237-334_00003	0.2453		100.0	
CCV 160-268364/1	09/06/16 10:14	82242-334_00001	0.2355		96.0	

## Detector: AV230

Lab Sample ID	Analysis Date	Reagent ID	Efficiency	Efficiency Limits	Efficiency Recovery	Recovery Limits
IC 160-223526/1	10/18/15 19:00	82247-334_00001	0.2509			
ICV 160-223645/1	11/01/15 19:19	82235-334_00001	0.2490		99.2	
CCV 160-268368/1	09/06/16 10:11	82247-334_00001	0.2386		95.1	

## Detector: AV232

Lab Sample ID	Analysis Date	Reagent ID	Efficiency	Efficiency Limits	Efficiency Recovery	Recovery Limits
IC 160-223528/1	10/18/15 21:31	82233-334_00001	0.2640			
ICV 160-223647/1	11/01/15 20:29	82232-334_00001	0.2614		99.0	
CCV 160-268370/1	09/06/16 10:09	82233-334_00001	0.2670		101.1	

### Calibration

Sample Name: ICV-9885;AV221-20151101  
Description:  
Detector: AV221

Analyst: 60040

Analysis Date: 11/1/2015 8:23:45PM

Calibration Type: Energy And Efficiency

### Source Info

Certificate ID: 82246-334  
Prepared by: Analytics  
Description:

Certification Date: 6/9/2010 12:00:00PM

### Acquisition

Detector: AV221 , SN: 50-117H5  
Acquisition Start Date: 11/1/2015 7:17:49PM

Energy Calibration Equation:

Gain = 7.4575 keV / Ch

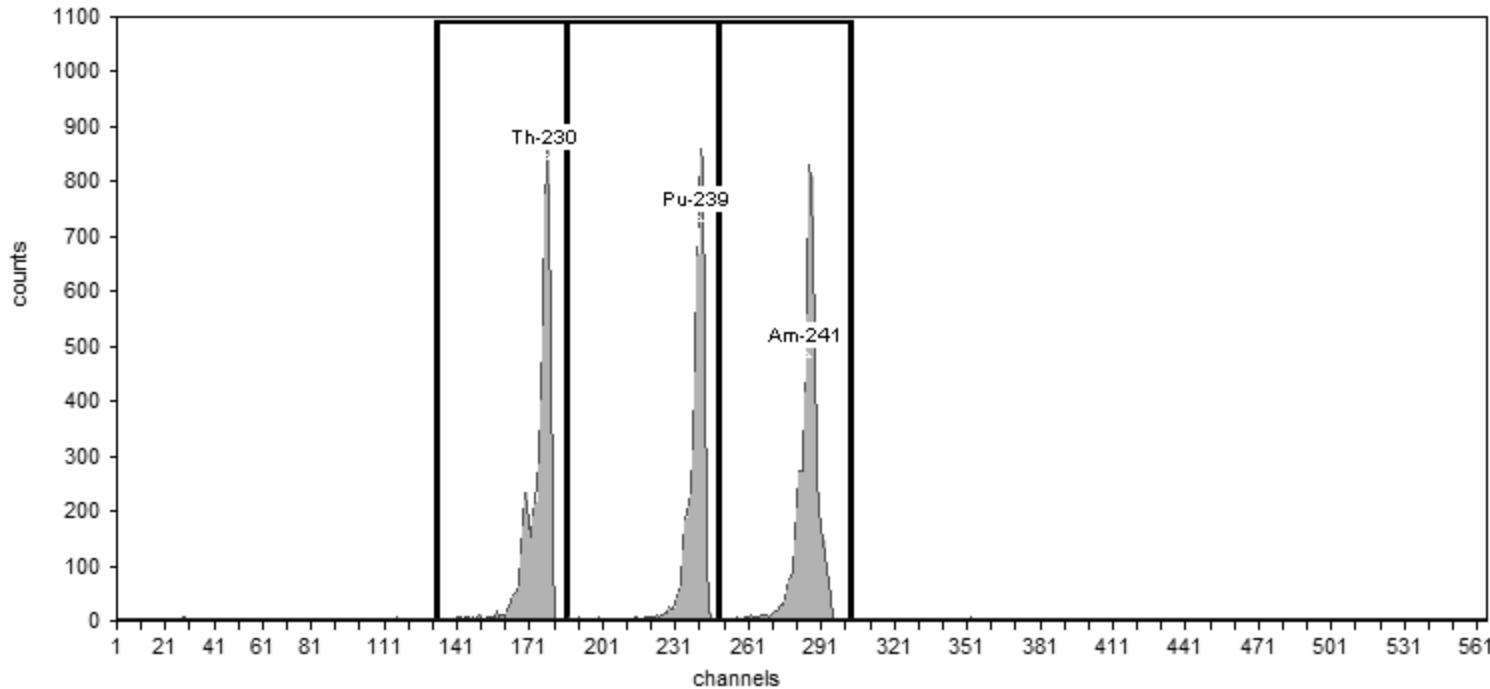
Live Time: 60.00 min.  
Real Time: 60.00 min.

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: ICV-9885;AV221-20151101

Efficiency: 25.27% +/- 0.48% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: No  
Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	30.05	5,130.00	85.50
Pu-239	240	5,155.40	186	249	32.50	4,814.00	80.23
Am-241	284	5,485.70	249	303	32.87	5,414.00	90.23

### Calibration

Sample Name: ICV-9794;AV222-20151101  
Description:  
Detector: AV222

Analyst: 60040  
Analysis Date: 11/1/2015 8:23:49PM  
Calibration Type: Energy And Efficiency

### Source Info

Certificate ID: 82242-334  
Prepared by: Analytics  
Description:

Certification Date: 6/8/2010 12:00:00PM

### Acquisition

Detector: AV222 , SN: 50-117J2  
Acquisition Start Date: 11/1/2015 7:18:03PM

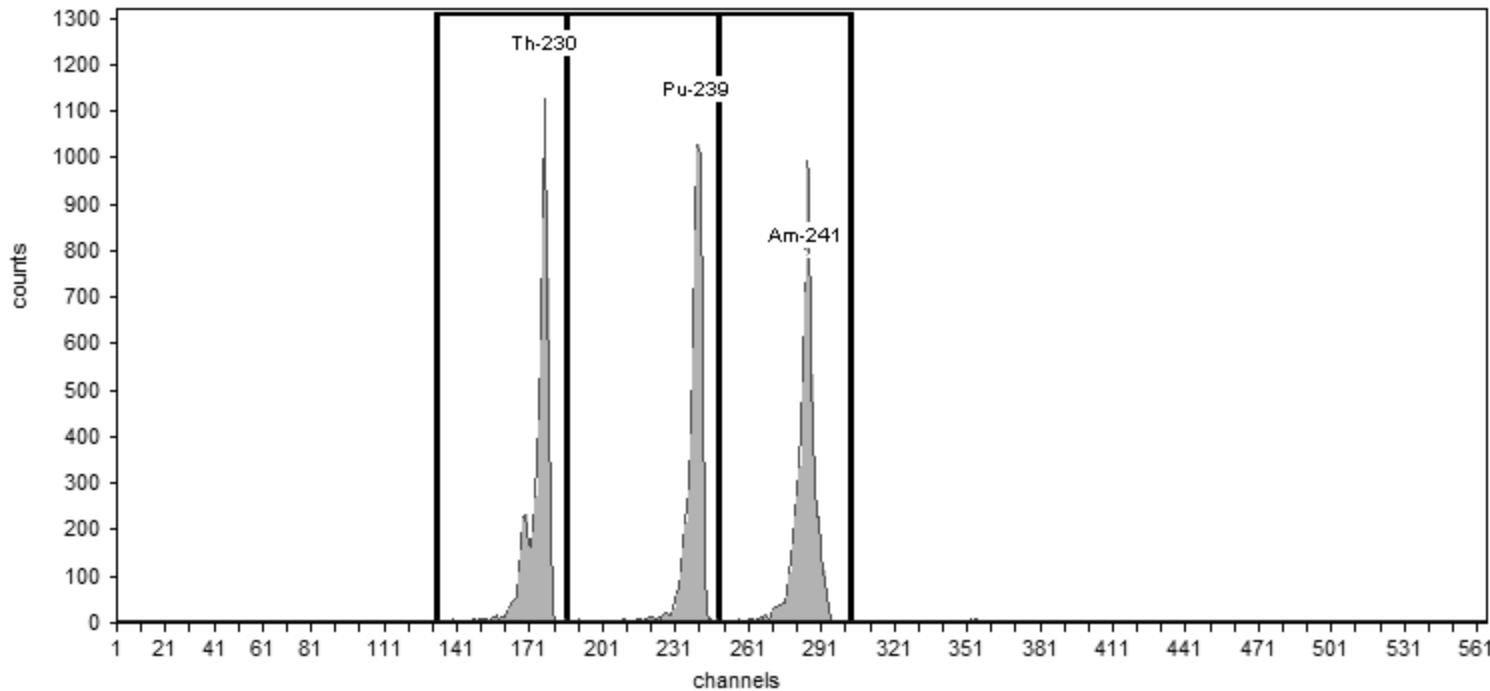
Energy Calibration Equation:  
Gain = 7.4575 keV / Ch

Live Time: 60.00 min.  
Real Time: 60.00 min.

Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: ICV-9794;AV222-20151101

Efficiency: 24.52% +/- 0.42% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: No  
Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	26.79	5,816.00	96.93
Pu-239	240	5,155.40	186	249	33.87	5,666.00	94.43
Am-241	284	5,485.70	249	303	31.78	6,248.00	104.13

### Calibration

Sample Name: ICV-9520;AV225-20151101  
Description:  
Detector: AV225

Analyst: 60040  
Analysis Date: 11/1/2015 8:24:01PM  
Calibration Type: Energy And Efficiency

### Source Info

Certificate ID: 82237-334  
Prepared by: Analytics  
Description:

Certification Date: 6/1/2010 12:00:00PM

### Acquisition

Detector: AV225 , SN: 50-117J7  
Acquisition Start Date: 11/1/2015 7:18:39PM

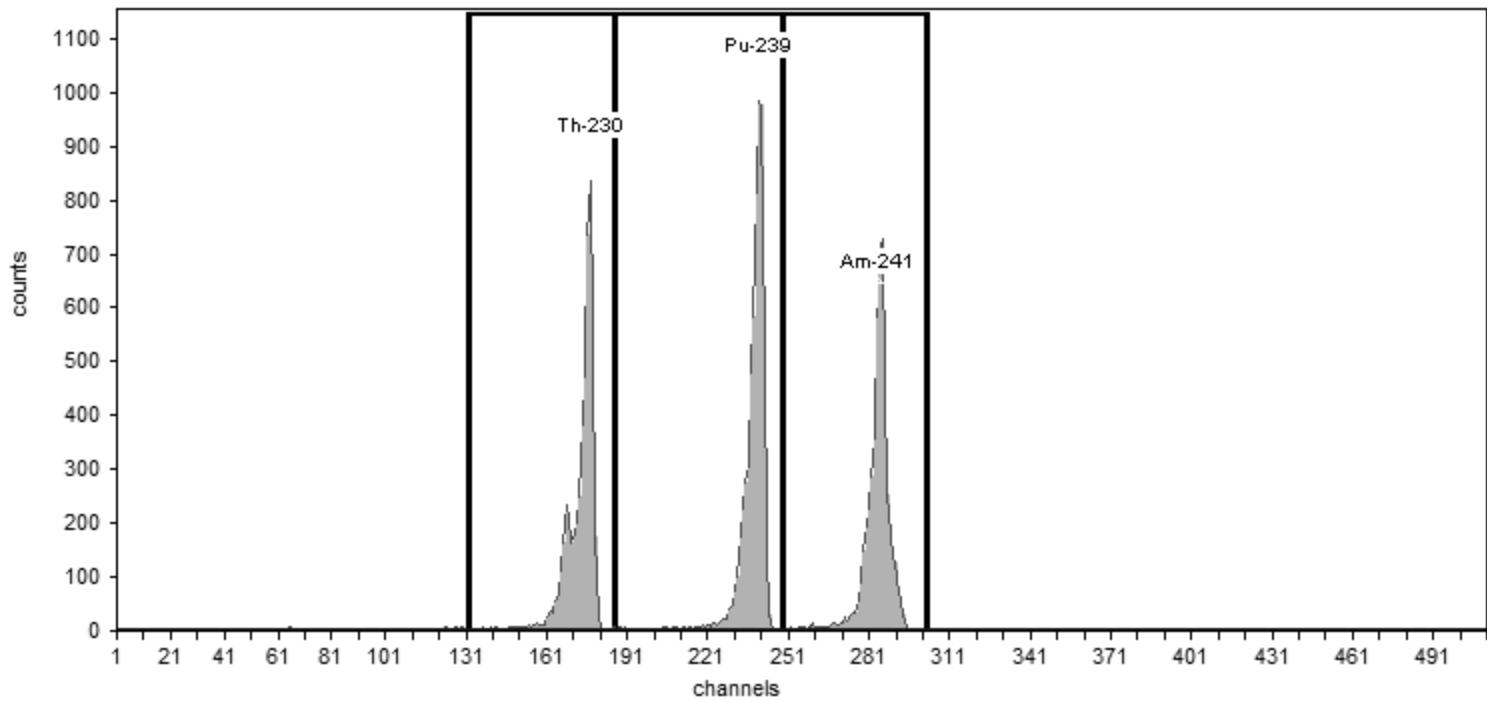
Energy Calibration Equation:  
Gain = 7.4575 keV / Ch

Live Time: 60.00 min.  
Real Time: 60.00 min.

Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: ICV-9520;AV225-20151101

Efficiency: 24.53% +/- 0.45% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: No  
Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	29.57	4,973.00	82.88
Pu-239	240	5,155.40	186	249	37.01	5,917.00	98.62
Am-241	284	5,485.70	249	303	33.07	4,880.00	81.33

### Calibration

Sample Name: ICV-8876;AV230-20151101  
Description:  
Detector: AV230

Analyst: 60040  
Analysis Date: 11/1/2015 8:24:16PM  
Calibration Type: Energy And Efficiency

### Source Info

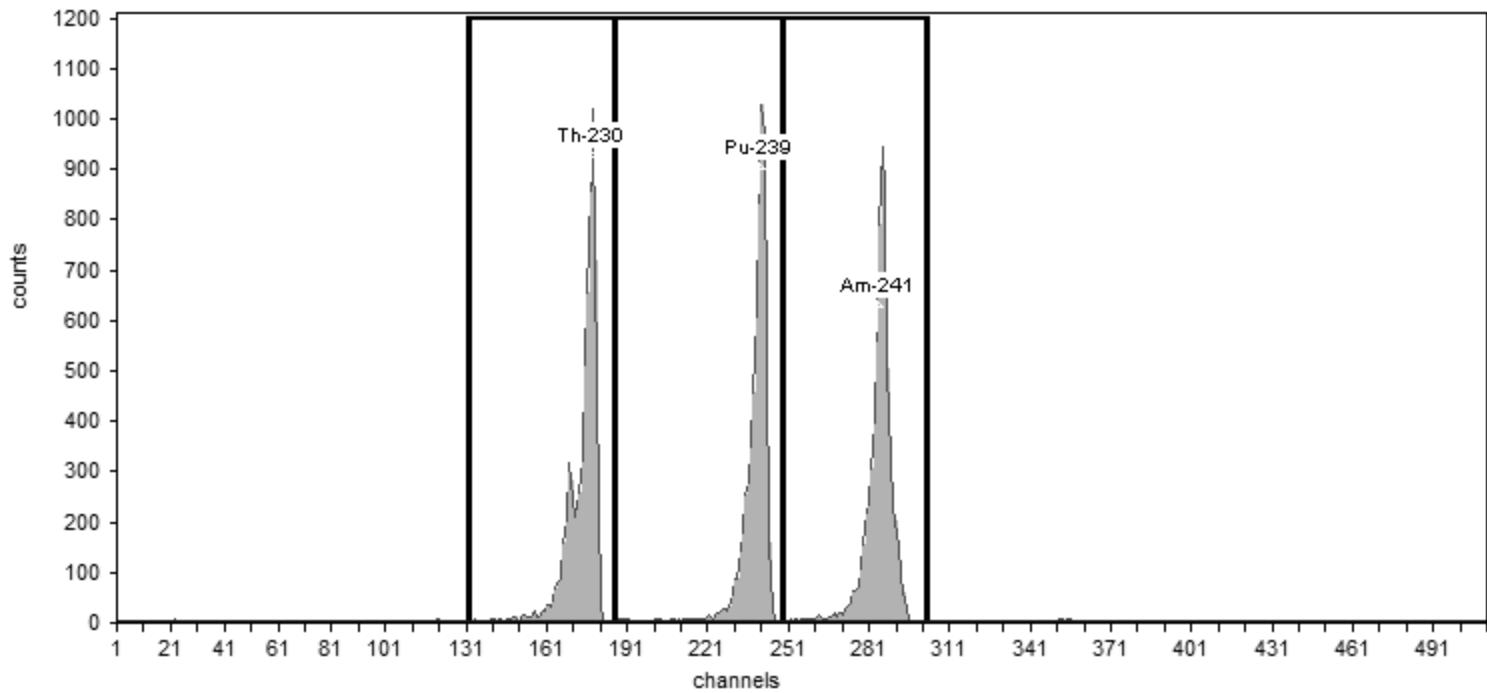
Certificate ID: 82235-334  
Prepared by: Analytics  
Description:

Certification Date: 6/4/2010 12:00:00PM

### Acquisition

Detector: AV230 , SN: 49-045J5  
Acquisition Start Date: 11/1/2015 7:19:55PM  
Live Time: 60.00 min.  
Real Time: 60.00 min.  
Efficiency Calibration Name: ICV-8876;AV230-20151101

Energy Calibration Equation:  
Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency: 24.90% +/- 0.40% TPU(2 sigma)



### General Analysis

Method: Manual (ROI) Initial Calibration: No  
Algorithm: Linear Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	32.97	6,467.00	107.78
Pu-239	240	5,155.40	186	249	35.00	6,255.00	104.25
Am-241	284	5,485.70	249	303	35.07	6,527.00	108.78

### Calibration

Sample Name: ICV-7107;AV232-20151101  
Description:  
Detector: AV232

Analyst: 60040  
Analysis Date: 11/1/2015 11:16:06PM  
Calibration Type: Energy And Efficiency

### Source Info

Certificate ID: 82232-334  
Prepared by: Analytics  
Description:

Certification Date: 6/3/2010 12:00:00PM

### Acquisition

Detector: AV232 , SN: 46-033p2  
Acquisition Start Date: 11/1/2015 8:29:20PM

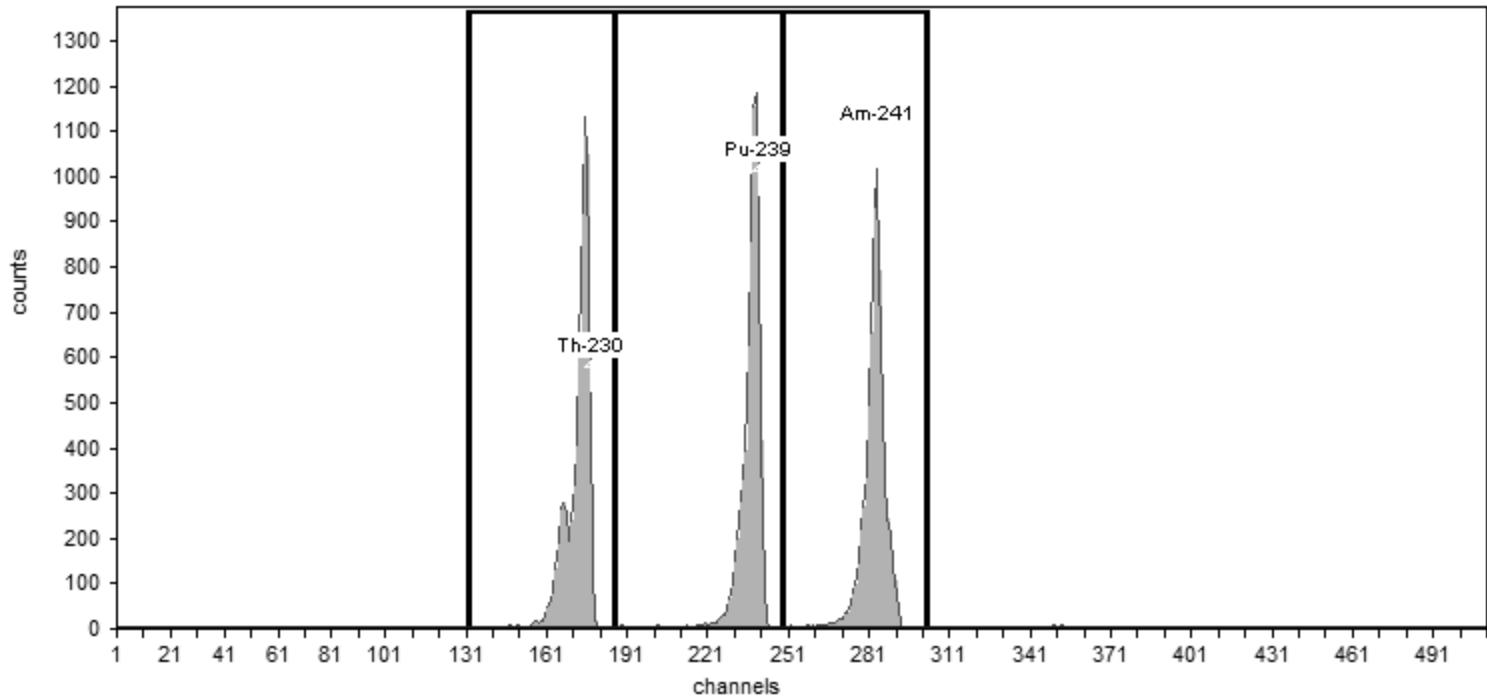
Energy Calibration Equation:  
Gain = 7.4575 keV / Ch

Live Time: 60.00 min.  
Real Time: 60.01 min.

Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: ICV-7107;AV232-20151101

Efficiency: 26.14% +/- 0.40% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: No  
Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	30.74	6,926.00	115.43
Pu-239	240	5,155.40	186	249	35.75	6,982.00	116.37
Am-241	284	5,485.70	249	303	36.13	6,817.00	113.62

# **Monthly Calibration Verifications**

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**Calibration**

Sample Name: CCV-8877;AV221-20160906

Analyst: 60040

Description:

Analysis Date: 9/6/2016 12:30:47PM

Detector: AV221

Calibration Type: Energy And Efficiency

Certificate ID: 82236-334

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**Source Info**

Certification Date: 6/2/2010 12:00:00PM

Prepared by: Analytics

Description:

---

**Acquisition**

Detector: AV221 , SN: 50-117H5

Energy Calibration Equation:

Acquisition Start Date: 9/6/2016 11:26:26AM

Gain = 7.4575 keV / Ch

Live Time: 60.00 min.

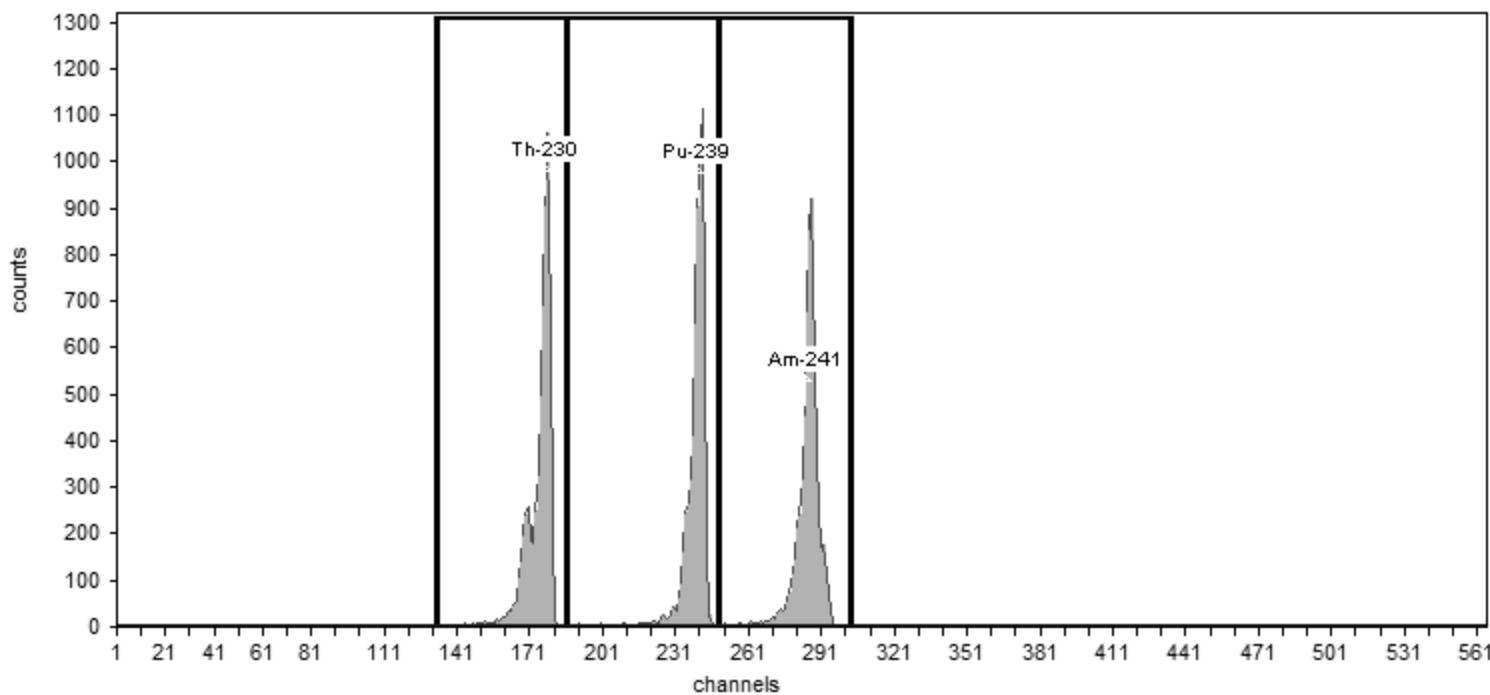
Offset = 3,366.95 keV

Real Time: 60.00 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: CCV-8877;AV221-201609

Efficiency: 24.98% +/- 0.41% TPU(2 sigma)



---

**General Analysis**

Method: Manual (ROI)

Initial Calibration: No

Algorithm: Linear

Shelf: 1

---

**Nuclide Activity Summary**

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	30.50	6,181.00	103.02
Pu-239	240	5,155.40	186	249	33.93	6,318.00	105.30
Am-241	284	5,485.70	249	303	33.67	6,065.00	101.08

### Calibration

Sample Name: CCV-9520;AV22-20160906  
Description:  
Detector: AV222

Analyst: 60040

Analysis Date: 9/6/2016 11:12:05AM

Calibration Type: Energy And Efficiency

### Source Info

Certificate ID: 82237-334  
Prepared by: Analytics  
Description:

Certification Date: 6/1/2010 12:00:00PM

### Acquisition

Detector: AV222 , SN: 50-117J2  
Acquisition Start Date: 9/6/2016 10:08:19AM  
Live Time: 60.00 min.  
Real Time: 60.00 min.

Energy Calibration Equation:

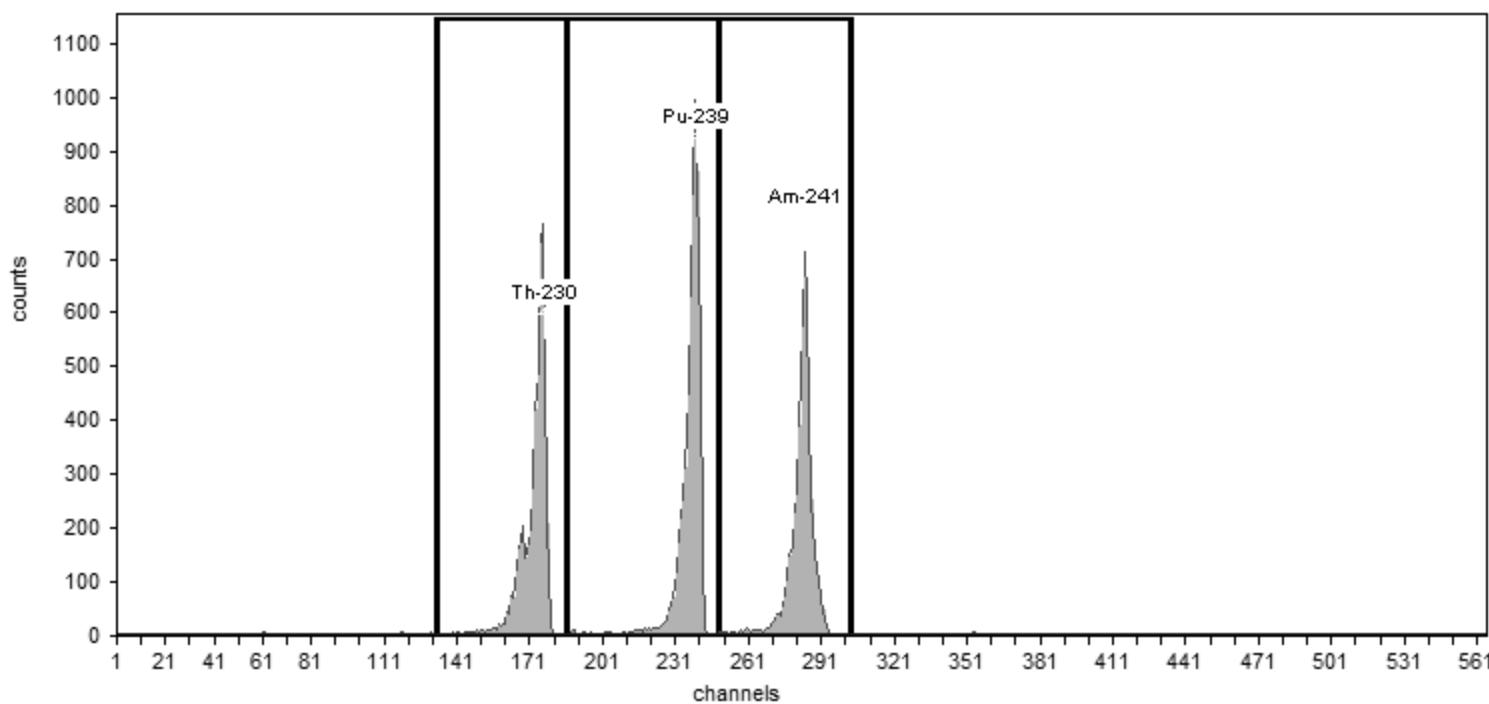
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: CCV-9520;AV22-20160906

Efficiency: 24.24% +/- 0.45% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)

Initial Calibration: No

Algorithm: Linear

Shelf: 1

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	35.11	4,957.00	82.62
Pu-239	240	5,155.40	186	249	35.83	5,880.00	98.00
Am-241	284	5,485.70	249	303	34.48	4,736.00	78.93

### Calibration

Sample Name: CCV-9794;AV225-20160906a  
Description:  
Detector: AV225

Analyst: 60040

Analysis Date: 9/6/2016 11:14:49AM

Calibration Type: Energy And Efficiency

### Source Info

Certificate ID: 82242-334  
Prepared by: Analytics  
Description:

Certification Date: 6/8/2010 12:00:00PM

### Acquisition

Detector: AV225 , SN: 50-117J7  
Acquisition Start Date: 9/6/2016 10:14:44AM  
Live Time: 60.00 min.  
Real Time: 60.00 min.

Energy Calibration Equation:

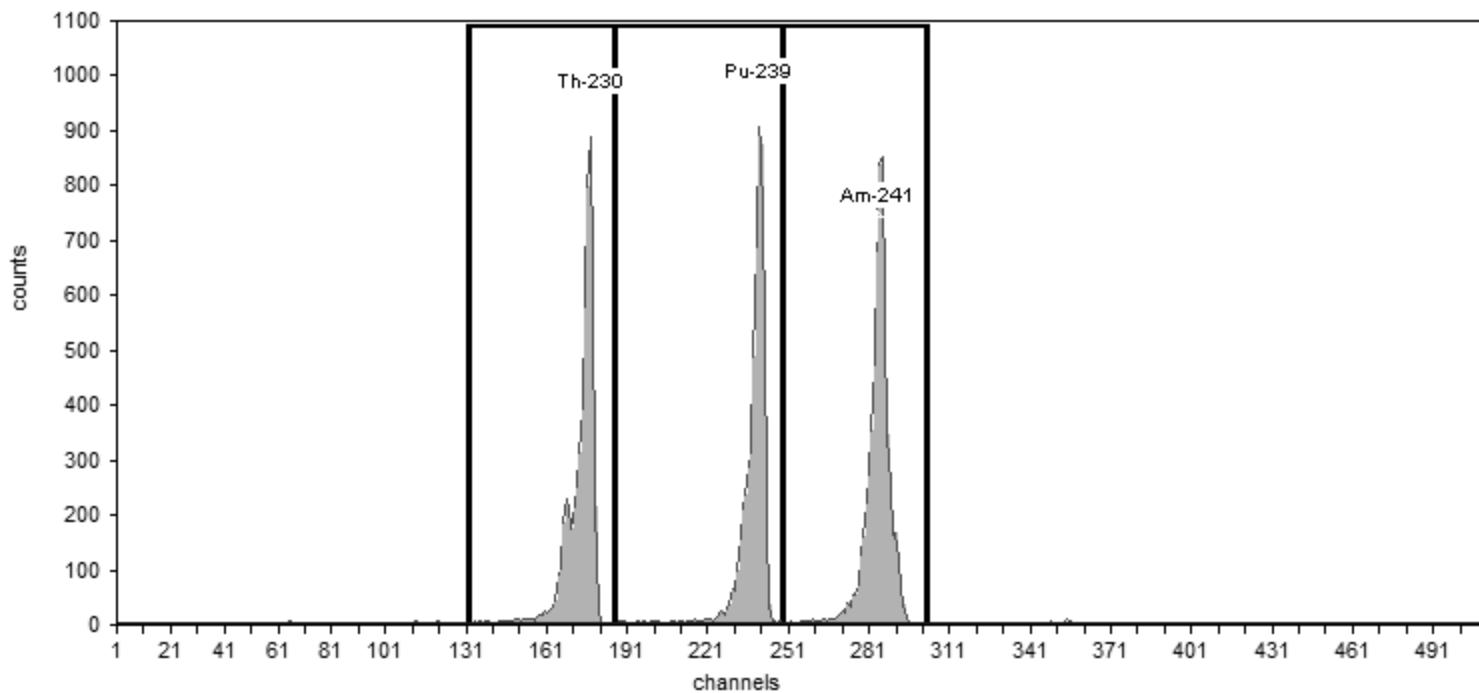
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: CCV-9794;AV225-201609

Efficiency: 23.55% +/- 0.41% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)

Initial Calibration: No

Algorithm: Linear

Shelf: 1

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	31.12	5,562.00	92.70
Pu-239	240	5,155.40	186	249	33.41	5,392.00	89.87
Am-241	284	5,485.70	249	303	37.22	6,070.00	101.17

**Calibration**

Sample Name: CCV-9886;AV230-20160906

Analyst: 60040

Description:

Analysis Date: 9/6/2016 11:14:28AM

Detector: AV230

Calibration Type: Energy And Efficiency

Certificate ID: 82247-334

**Source Info**

Certification Date: 6/10/2010 12:00:00PM

Prepared by: Analytics

Description:

**Acquisition**

Detector: AV230 , SN: 49-045J5

Energy Calibration Equation:

Acquisition Start Date: 9/6/2016 10:11:50AM

Gain = 7.4575 keV / Ch

Live Time: 60.00 min.

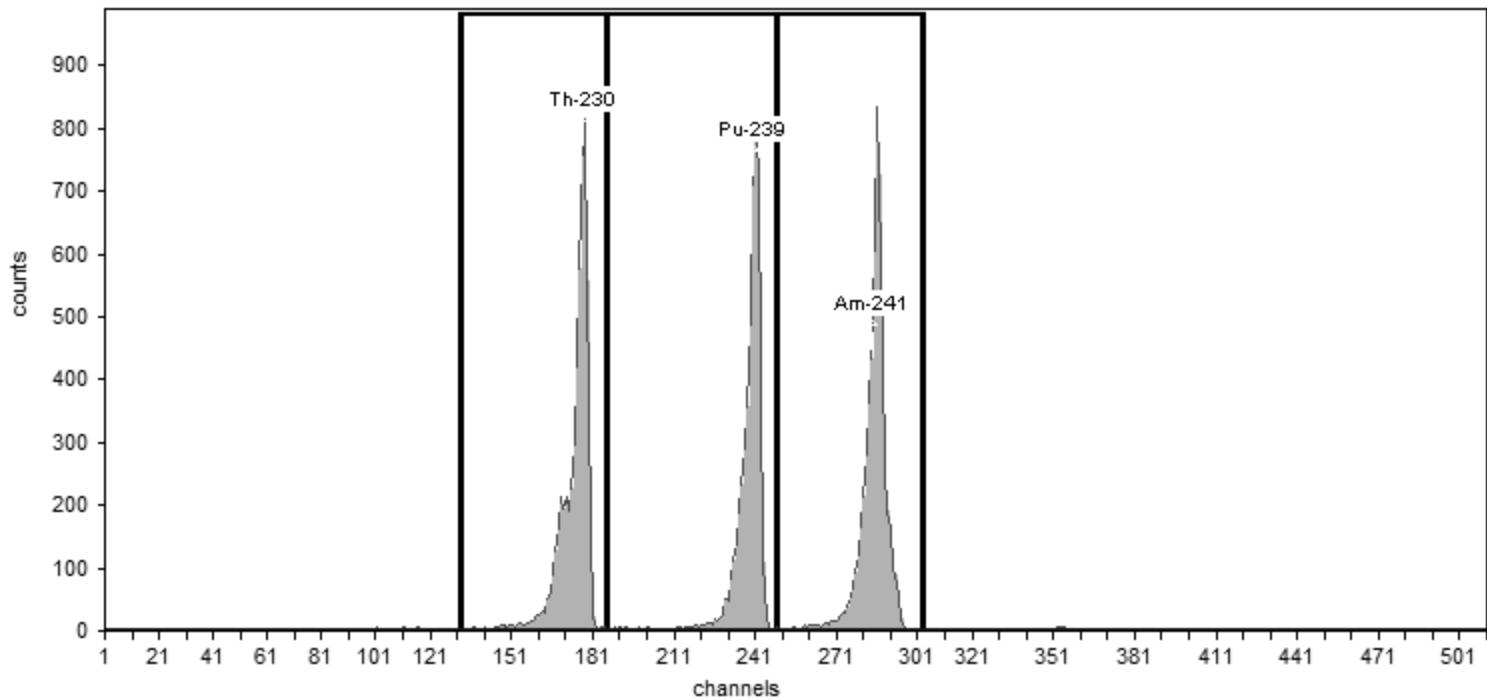
Offset = 3,366.95 keV

Real Time: 60.00 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: CCV-9886;AV230-201609

Efficiency: 23.86% +/- 0.44% TPU(2 sigma)

**General Analysis**

Method: Manual (ROI)

Initial Calibration: No

Algorithm: Linear

Shelf: 1

**Nuclide Activity Summary**

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	33.28	5,317.00	88.62
Pu-239	240	5,155.40	186	249	35.17	4,901.00	81.68
Am-241	284	5,485.70	249	303	31.90	5,444.00	90.73

---

**Calibration**

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Sample Name: CCV-8874;AV232-20160906

Analyst: 60040

Description:

Analysis Date: 9/6/2016 11:12:22AM

Detector: AV232

Calibration Type: Energy And Efficiency

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**Source Info**

---

Certificate ID: 82233-334

Certification Date: 6/3/2010 12:00:00PM

Prepared by: Analytics

Description:

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**Acquisition**

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Detector: AV232 , SN: 46-033p2

Energy Calibration Equation:

Acquisition Start Date: 9/6/2016 10:09:23AM

Gain = 7.4575 keV / Ch

Live Time: 60.00 min.

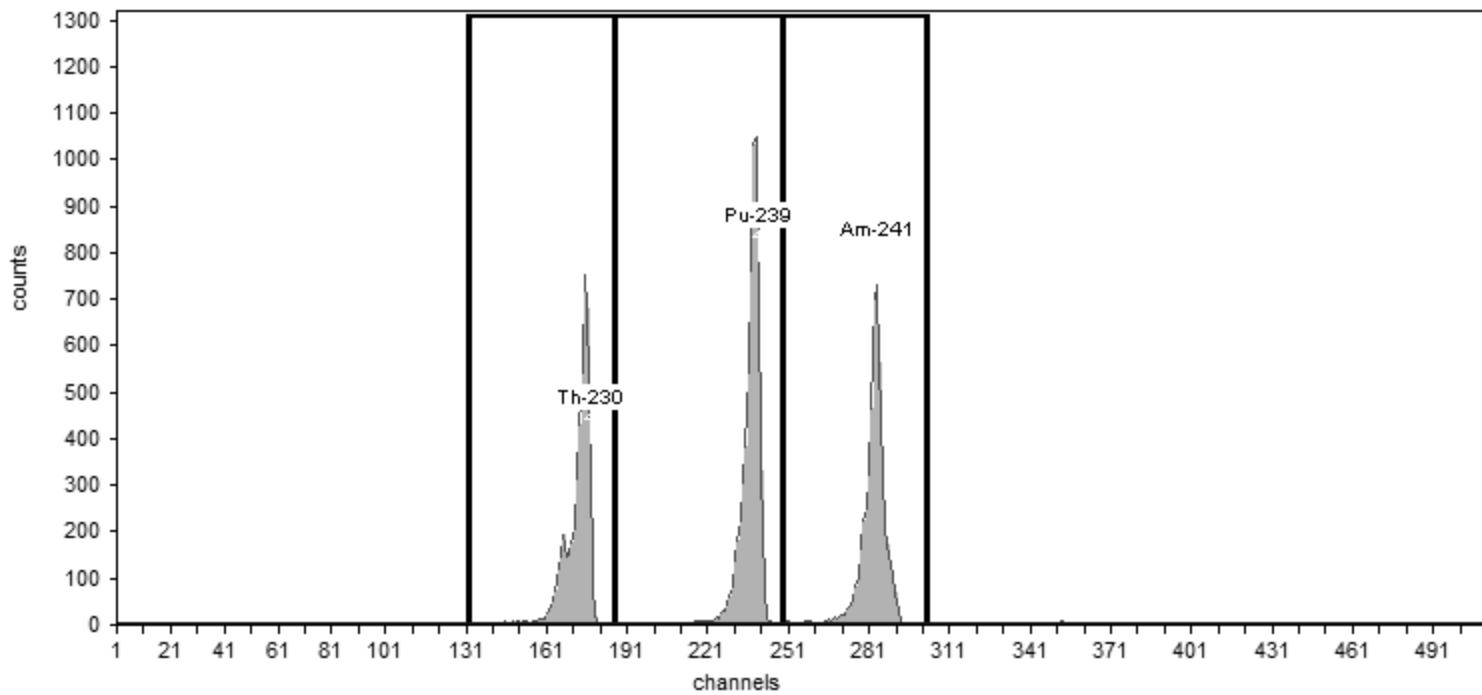
Offset = 3,366.95 keV

Real Time: 60.00 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: CCV-8874;AV232-201609

Efficiency: 26.70% +/- 0.50% TPU(2 sigma)



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**General Analysis**

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Method: Manual (ROI)

Initial Calibration: No

Algorithm: Linear

Shelf: 1

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**Nuclide Activity Summary**

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Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	33.00	4,549.00	75.82
Pu-239	240	5,155.40	186	249	34.66	6,082.00	101.37
Am-241	284	5,485.70	249	303	33.79	4,834.00	80.57

# **Monthly Backgrounds**

Sample Name: ICB;AV221

**Sample**

Spectrum #1 Analysis #1

Comment:

Analyst: 60040

Batch Name: August2016

**Batch**

Description:

**Acquisition**

Detector: AV221 , SN: 50-117H5

Energy Calibration Equation:

Acquisition Start Date: 9/1/2016 3:17:19PM

Gain = 7.4575 keV / Ch

Live Time: 960.00 min.

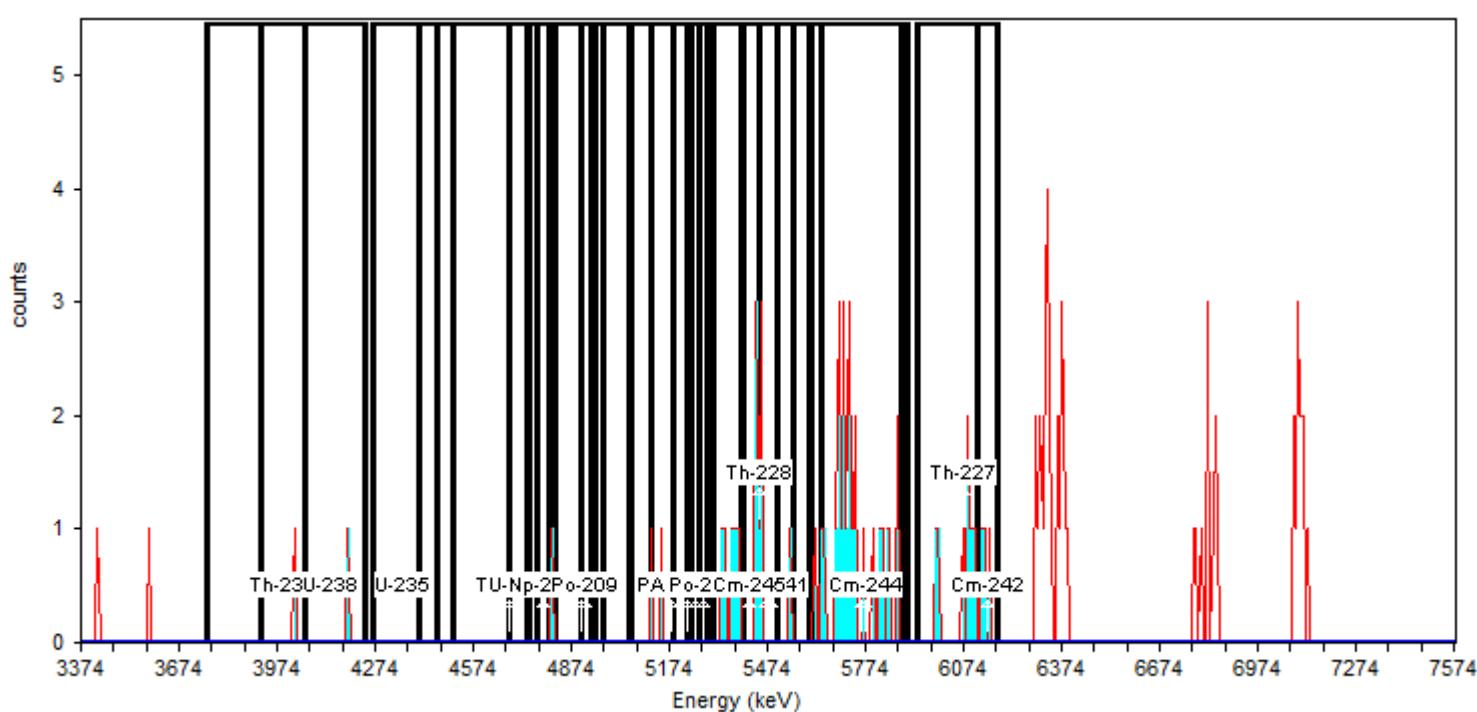
Offset = 3,366.95 keV

Real Time: 960.01 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Calibration Name: IC-8877;AV221-20151018

Calibration Date: 10/18/2015 9:20:01PM

**General Analysis**

Analysis Method: Absolute ROI Analysis, Set Name = 11/05\_BackgroundROI

Nuclide Library: Background ROI Library

Total Background Counts: 103.00

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***Nuclide Summary (ROI)***

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<b><u>RegionName</u></b>	<b><u>Peak Energy</u></b>	<b><u>Start Energy</u></b>	<b><u>End Energy</u></b>	<b><u>GrossCounts</u></b>	<b><u>Count Rate</u></b>	<b><u>CR Uncertainty</u></b>
	(keV)	(keV)	(keV)		(CPM)	(CPM)
Th-232	3,985.93	3,754.75	4,053.05	1.00	1.042E-003	1.473E-003
U-238	4,135.08	3,918.81	4,239.49	2.00	2.083E-003	1.804E-003
U-235	4,358.81	4,261.86	4,463.21	0.00	0.000E+000	1.473E-003
Th-230	4,679.48	4,403.55	4,746.60	0.00	0.000E+000	1.473E-003
U-234	4,709.31	4,507.96	4,821.17	1.00	1.042E-003	1.473E-003
Pu-242	4,903.21	4,679.48	4,947.95	1.00	1.042E-003	1.473E-003
Th-229	4,858.46	4,739.14	5,119.48	2.00	2.083E-003	1.804E-003
Np-237	4,783.89	4,768.97	4,806.26	0.00	0.000E+000	1.473E-003
Po-209	4,918.12	4,903.21	4,933.04	0.00	0.000E+000	1.473E-003
Pu-239	5,179.14	4,970.33	5,238.80	2.00	2.083E-003	1.804E-003
Am-243	5,231.34	5,052.36	5,305.92	2.00	2.083E-003	1.804E-003
U-232	5,253.71	5,059.82	5,402.86	8.00	8.333E-003	3.125E-003
Th-228	5,447.61	5,186.59	5,507.27	13.00	1.354E-002	3.898E-003
Po-210	5,276.09	5,231.34	5,291.00	0.00	0.000E+000	1.473E-003
Pu-238	5,469.98	5,268.63	5,552.01	14.00	1.458E-002	4.034E-003
Am-241	5,484.90	5,298.46	5,604.22	14.00	1.458E-002	4.034E-003
Cm-245	5,417.78	5,395.41	5,447.61	4.00	4.167E-003	2.329E-003
Pu-236	5,760.83	5,611.67	5,887.60	27.00	2.812E-002	5.512E-003
Cm-244	5,775.74	5,641.51	5,902.52	26.00	2.708E-002	5.413E-003
Th-227	6,074.04	5,932.35	6,178.45	11.00	1.146E-002	3.608E-003
Cm-242	6,148.62	6,118.79	6,178.45	3.00	3.125E-003	2.083E-003

Sample Name: ICB;AV222

**Sample**

Spectrum #1 Analysis #1

Comment:

Analyst: 60040

Batch Name: August2016a

**Batch**

Description:

**Acquisition**

Detector: AV222 , SN: 50-117J2

Energy Calibration Equation:

Acquisition Start Date: 9/2/2016 10:55:31AM

Gain = 7.4575 keV / Ch

Live Time: 960.00 min.

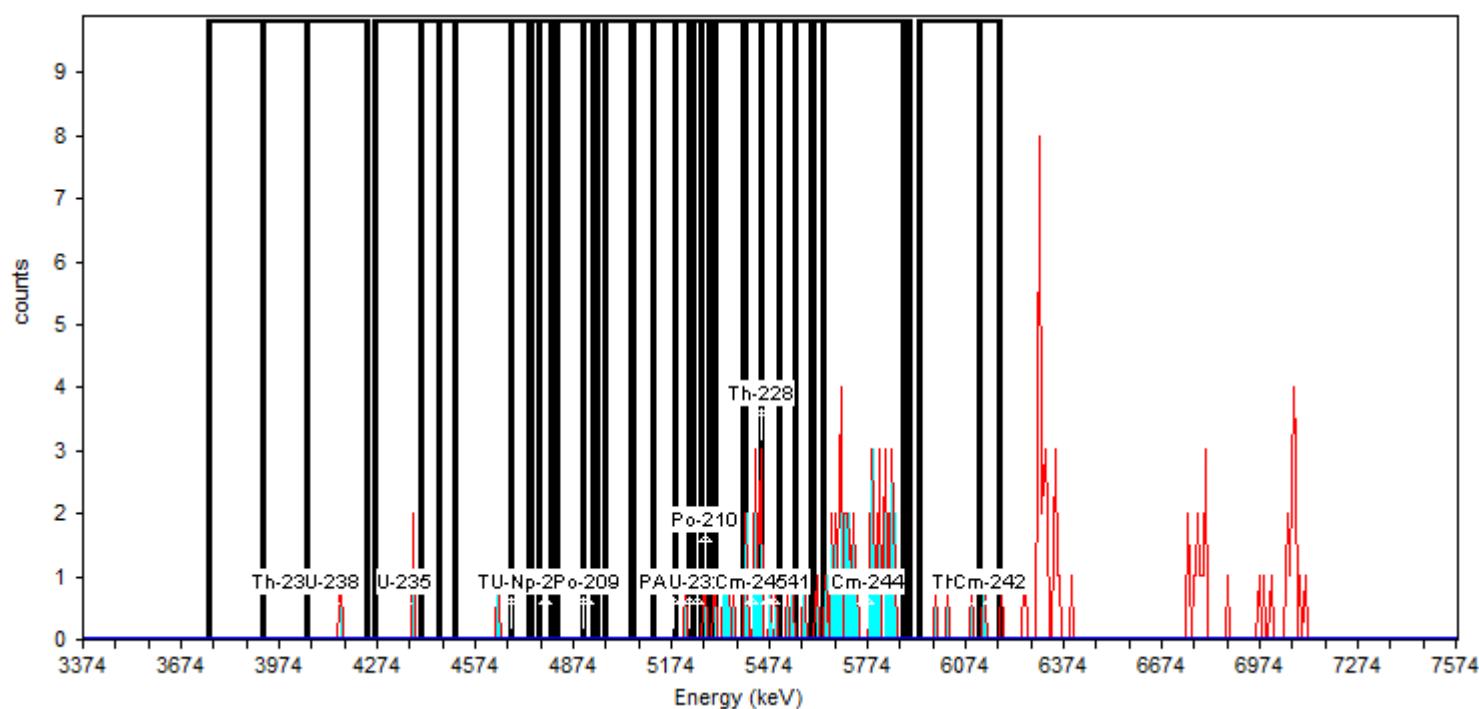
Offset = 3,366.95 keV

Real Time: 960.00 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Calibration Name: IC-9520;AV222-20151018

Calibration Date: 10/18/2015 9:20:05PM

**General Analysis**

Analysis Method: Absolute ROI Analysis, Set Name = 11/05\_BackgroundROI

Nuclide Library: Background ROI Library

Total Background Counts: 125.00

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**Nuclide Summary (ROI)**

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RegionName	Peak Energy	Start Energy	End Energy	GrossCounts	Count Rate	CR Uncertainty
	(keV)	(keV)	(keV)		(CPM)	(CPM)
Th-232	3,985.93	3,754.75	4,053.05	0.00	0.000E+000	1.473E-003
U-238	4,135.08	3,918.81	4,239.49	1.00	1.042E-003	1.473E-003
U-235	4,358.81	4,261.86	4,463.21	2.00	2.083E-003	1.804E-003
Th-230	4,679.48	4,403.55	4,746.60	1.00	1.042E-003	1.473E-003
U-234	4,709.31	4,507.96	4,821.17	1.00	1.042E-003	1.473E-003
Pu-242	4,903.21	4,679.48	4,947.95	0.00	0.000E+000	1.473E-003
Th-229	4,858.46	4,739.14	5,119.48	0.00	0.000E+000	1.473E-003
Np-237	4,783.89	4,768.97	4,806.26	0.00	0.000E+000	1.473E-003
Po-209	4,918.12	4,903.21	4,933.04	0.00	0.000E+000	1.473E-003
Pu-239	5,179.14	4,970.33	5,238.80	1.00	1.042E-003	1.473E-003
Am-243	5,231.34	5,052.36	5,305.92	3.00	3.125E-003	2.083E-003
U-232	5,253.71	5,059.82	5,402.86	9.00	9.375E-003	3.294E-003
Th-228	5,447.61	5,186.59	5,507.27	19.00	1.979E-002	4.658E-003
Po-210	5,276.09	5,231.34	5,291.00	1.00	1.042E-003	1.473E-003
Pu-238	5,469.98	5,268.63	5,552.01	20.00	2.083E-002	4.774E-003
Am-241	5,484.90	5,298.46	5,604.22	20.00	2.083E-002	4.774E-003
Cm-245	5,417.78	5,395.41	5,447.61	10.00	1.042E-002	3.455E-003
Pu-236	5,760.83	5,611.67	5,887.60	40.00	4.167E-002	6.670E-003
Cm-244	5,775.74	5,641.51	5,902.52	39.00	4.062E-002	6.588E-003
Th-227	6,074.04	5,932.35	6,178.45	4.00	4.167E-003	2.329E-003
Cm-242	6,148.62	6,118.79	6,178.45	1.00	1.042E-003	1.473E-003

Sample Name: ICB;AV225

**Sample**

Spectrum #1 Analysis #1

Comment:

Analyst: 60040

Batch Name: August2016

**Batch**

Description:

**Acquisition**

Detector: AV225 , SN: 50-117J7

Energy Calibration Equation:

Acquisition Start Date: 9/1/2016 3:17:20PM

Gain = 7.4575 keV / Ch

Live Time: 960.00 min.

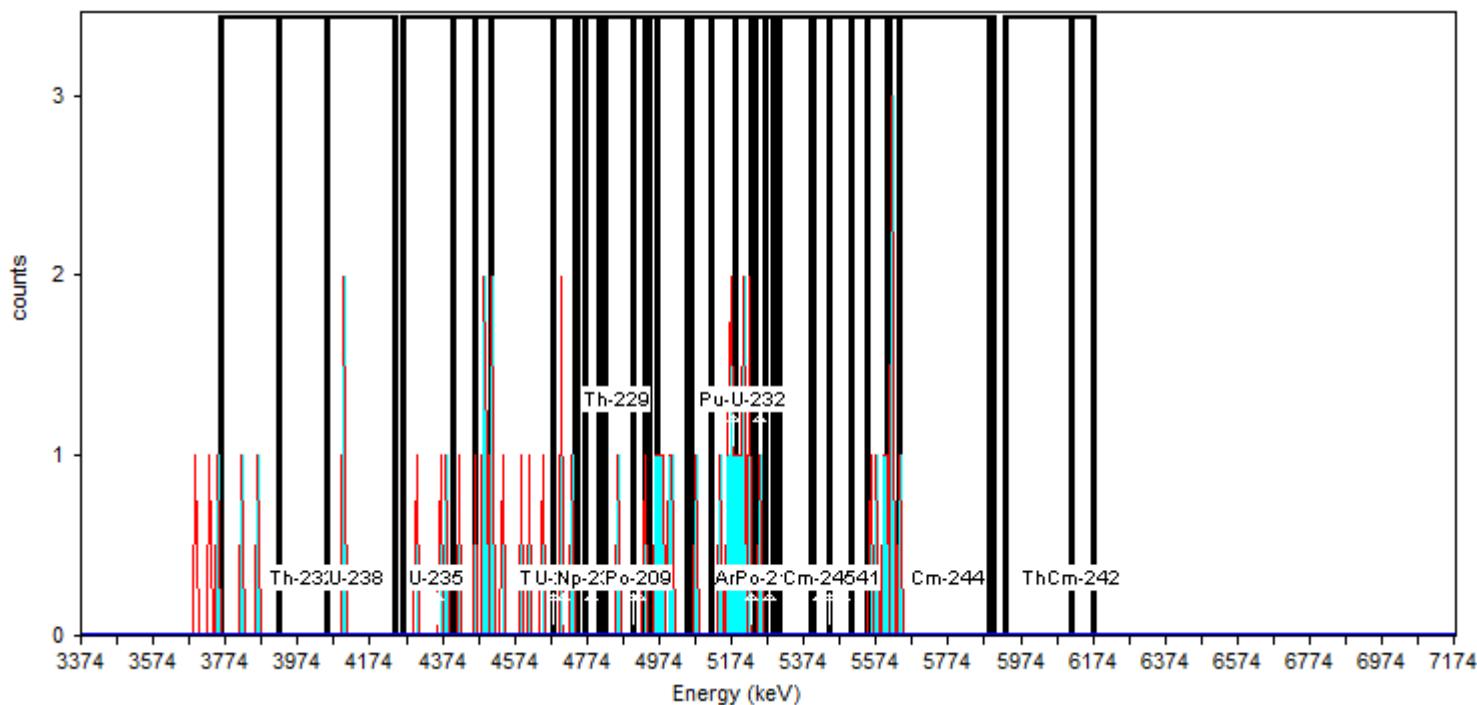
Offset = 3,366.95 keV

Real Time: 973.17 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Calibration Name: IC-9794;AV225-20151018

Calibration Date: 10/18/2015 9:20:17PM

**General Analysis**

Analysis Method: Absolute ROI Analysis, Set Name = 11/05\_BackgroundROI

Nuclide Library: Background ROI Library

Total Background Counts: 54.00

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**Nuclide Summary (ROI)**

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RegionName	Peak Energy	Start Energy	End Energy	GrossCounts	Count Rate	CR Uncertainty
	(keV)	(keV)	(keV)		(CPM)	(CPM)
Th-232	3,985.93	3,754.75	4,053.05	2.00	2.083E-003	1.804E-003
U-238	4,135.08	3,918.81	4,239.49	2.00	2.083E-003	1.804E-003
U-235	4,358.81	4,261.86	4,463.21	5.00	5.208E-003	2.552E-003
Th-230	4,679.48	4,403.55	4,746.60	14.00	1.458E-002	4.034E-003
U-234	4,709.31	4,507.96	4,821.17	9.00	9.375E-003	3.294E-003
Pu-242	4,903.21	4,679.48	4,947.95	5.00	5.208E-003	2.552E-003
Th-229	4,858.46	4,739.14	5,119.48	9.00	9.375E-003	3.294E-003
Np-237	4,783.89	4,768.97	4,806.26	0.00	0.000E+000	1.473E-003
Po-209	4,918.12	4,903.21	4,933.04	1.00	1.042E-003	1.473E-003
Pu-239	5,179.14	4,970.33	5,238.80	18.00	1.875E-002	4.541E-003
Am-243	5,231.34	5,052.36	5,305.92	14.00	1.458E-002	4.034E-003
U-232	5,253.71	5,059.82	5,402.86	14.00	1.458E-002	4.034E-003
Th-228	5,447.61	5,186.59	5,507.27	8.00	8.333E-003	3.125E-003
Po-210	5,276.09	5,231.34	5,291.00	1.00	1.042E-003	1.473E-003
Pu-238	5,469.98	5,268.63	5,552.01	0.00	0.000E+000	1.473E-003
Am-241	5,484.90	5,298.46	5,604.22	4.00	4.167E-003	2.329E-003
Cm-245	5,417.78	5,395.41	5,447.61	0.00	0.000E+000	1.473E-003
Pu-236	5,760.83	5,611.67	5,887.60	4.00	4.167E-003	2.329E-003
Cm-244	5,775.74	5,641.51	5,902.52	1.00	1.042E-003	1.473E-003
Th-227	6,074.04	5,932.35	6,178.45	0.00	0.000E+000	1.473E-003
Cm-242	6,148.62	6,118.79	6,178.45	0.00	0.000E+000	1.473E-003

Sample Name: ICB;AV230

**Sample**

Spectrum #1 Analysis #1

Comment:

Analyst: 60040

Batch Name: August2016

**Batch**

Description:

**Acquisition**

Detector: AV230 , SN: 49-045J5

Energy Calibration Equation:

Acquisition Start Date: 9/1/2016 3:17:21PM

Gain = 7.4575 keV / Ch

Live Time: 960.00 min.

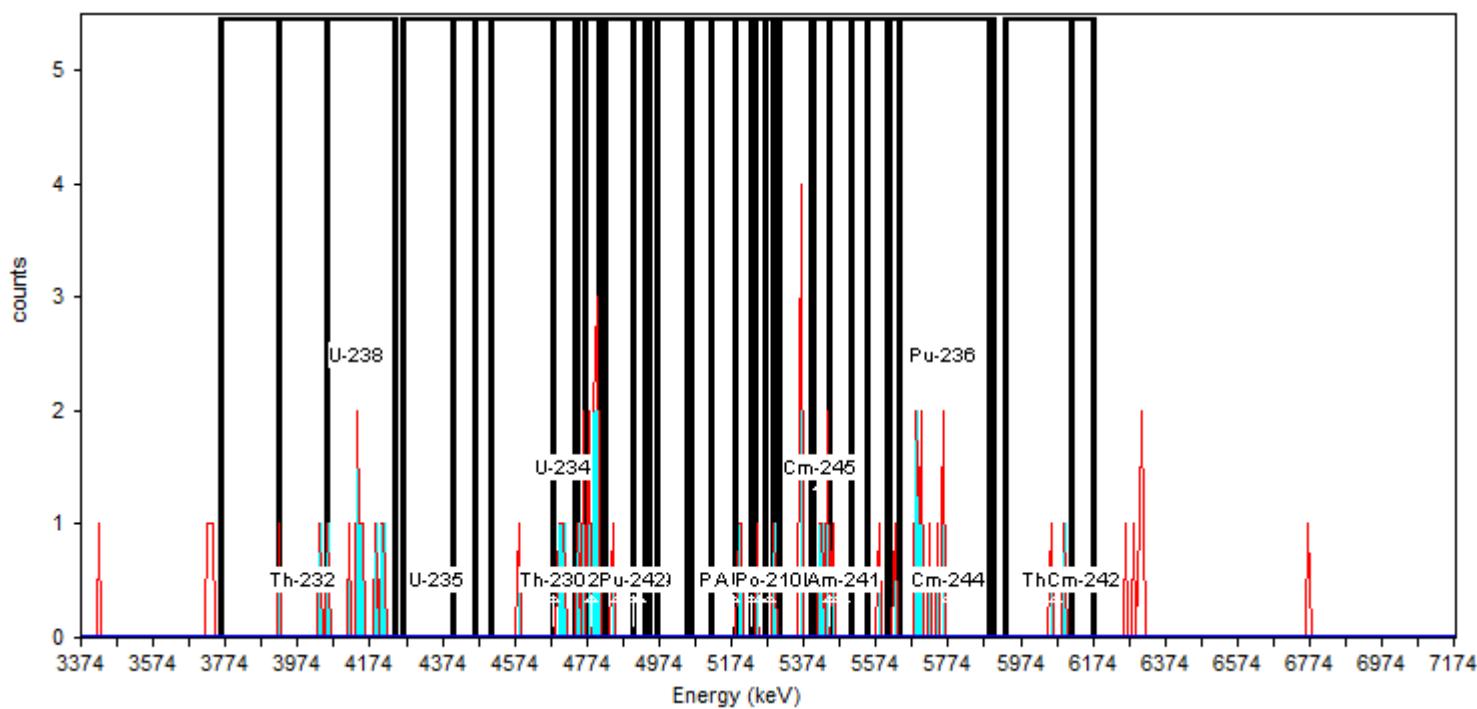
Offset = 3,366.95 keV

Real Time: 960.00 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Calibration Name: IC-9886;AV230-20151018

Calibration Date: 10/18/2015 9:20:40PM

**General Analysis**

Analysis Method: Absolute ROI Analysis, Set Name = 11/05\_BackgroundROI

Nuclide Library: Background ROI Library

Total Background Counts: 63.00

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**Nuclide Summary (ROI)**

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RegionName	Peak Energy	Start Energy	End Energy	GrossCounts	Count Rate	CR Uncertainty
	(keV)	(keV)	(keV)		(CPM)	(CPM)
Th-229	4,858.46	4,739.14	5,119.48	12.00	1.250E-002	3.756E-003
Np-237	4,783.89	4,768.97	4,806.26	8.00	8.333E-003	3.125E-003
Po-209	4,918.12	4,903.21	4,933.04	0.00	0.000E+000	1.473E-003
Pu-239	5,179.14	4,970.33	5,238.80	2.00	2.083E-003	1.804E-003
Am-243	5,231.34	5,052.36	5,305.92	4.00	4.167E-003	2.329E-003
U-232	5,253.71	5,059.82	5,402.86	8.00	8.333E-003	3.125E-003
Th-228	5,447.61	5,186.59	5,507.27	13.00	1.354E-002	3.898E-003
Po-210	5,276.09	5,231.34	5,291.00	2.00	2.083E-003	1.804E-003
Pu-238	5,469.98	5,268.63	5,552.01	10.00	1.042E-002	3.455E-003
Am-241	5,484.90	5,298.46	5,604.22	10.00	1.042E-002	3.455E-003
Cm-245	5,417.78	5,395.41	5,447.61	4.00	4.167E-003	2.329E-003
Pu-236	5,760.83	5,611.67	5,887.60	10.00	1.042E-002	3.455E-003
Cm-244	5,775.74	5,641.51	5,902.52	9.00	9.375E-003	3.294E-003
Th-227	6,074.04	5,932.35	6,178.45	2.00	2.083E-003	1.804E-003
Cm-242	6,148.62	6,118.79	6,178.45	0.00	0.000E+000	1.473E-003
Th-232	3,985.93	3,754.75	4,053.05	3.00	3.125E-003	2.083E-003
U-238	4,135.08	3,918.81	4,239.49	11.00	1.146E-002	3.608E-003
U-235	4,358.81	4,261.86	4,463.21	0.00	0.000E+000	1.473E-003
Th-230	4,679.48	4,403.55	4,746.60	5.00	5.208E-003	2.552E-003
U-234	4,709.31	4,507.96	4,821.17	15.00	1.563E-002	4.167E-003
Pu-242	4,903.21	4,679.48	4,947.95	15.00	1.563E-002	4.167E-003

Sample Name: ICB;AV232

**Sample**

Spectrum #1 Analysis #1

Comment:

Analyst: 60040

Batch Name: August2016

**Batch**

Description:

**Acquisition**

Detector: AV232 , SN: 46-033p2

Energy Calibration Equation:

Acquisition Start Date: 9/1/2016 3:17:21PM

Gain = 7.4575 keV / Ch

Live Time: 960.00 min.

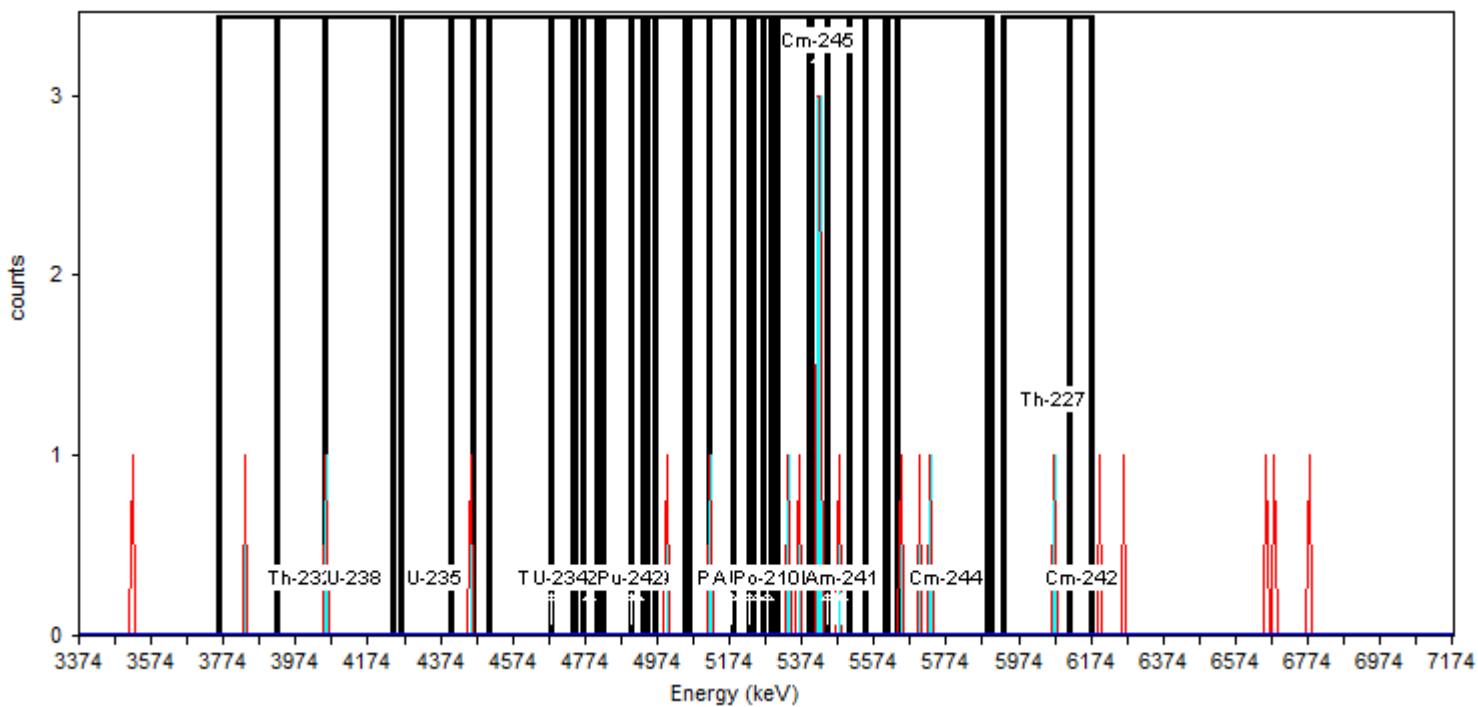
Offset = 3,366.95 keV

Real Time: 960.00 min.

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Calibration Name: IC-8874;AV232-20151018

Calibration Date: 10/19/2015 4:11:30PM

**General Analysis**

Analysis Method: Absolute ROI Analysis, Set Name = 11/05\_BackgroundROI

Nuclide Library: Background ROI Library

Total Background Counts: 24.00

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**Nuclide Summary (ROI)**

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RegionName	Peak Energy	Start Energy	End Energy	GrossCounts	Count Rate	CR Uncertainty
	(keV)	(keV)	(keV)		(CPM)	(CPM)
Th-229	4,858.46	4,739.14	5,119.48	2.00	2.083E-003	1.804E-003
Np-237	4,783.89	4,768.97	4,806.26	0.00	0.000E+000	1.473E-003
Po-209	4,918.12	4,903.21	4,933.04	0.00	0.000E+000	1.473E-003
Pu-239	5,179.14	4,970.33	5,238.80	2.00	2.083E-003	1.804E-003
Am-243	5,231.34	5,052.36	5,305.92	1.00	1.042E-003	1.473E-003
U-232	5,253.71	5,059.82	5,402.86	3.00	3.125E-003	2.083E-003
Th-228	5,447.61	5,186.59	5,507.27	9.00	9.375E-003	3.294E-003
Po-210	5,276.09	5,231.34	5,291.00	0.00	0.000E+000	1.473E-003
Pu-238	5,469.98	5,268.63	5,552.01	9.00	9.375E-003	3.294E-003
Am-241	5,484.90	5,298.46	5,604.22	9.00	9.375E-003	3.294E-003
Cm-245	5,417.78	5,395.41	5,447.61	6.00	6.250E-003	2.756E-003
Pu-236	5,760.83	5,611.67	5,887.60	3.00	3.125E-003	2.083E-003
Cm-244	5,775.74	5,641.51	5,902.52	3.00	3.125E-003	2.083E-003
Th-227	6,074.04	5,932.35	6,178.45	1.00	1.042E-003	1.473E-003
Cm-242	6,148.62	6,118.79	6,178.45	0.00	0.000E+000	1.473E-003
Th-232	3,985.93	3,754.75	4,053.05	2.00	2.083E-003	1.804E-003
U-238	4,135.08	3,918.81	4,239.49	1.00	1.042E-003	1.473E-003
U-235	4,358.81	4,261.86	4,463.21	1.00	1.042E-003	1.473E-003
Th-230	4,679.48	4,403.55	4,746.60	1.00	1.042E-003	1.473E-003
U-234	4,709.31	4,507.96	4,821.17	0.00	0.000E+000	1.473E-003
Pu-242	4,903.21	4,679.48	4,947.95	0.00	0.000E+000	1.473E-003

# **Run Logs**

# Alpha Spectroscopy Run Log

## Detector: AV221

Analysis Date	Minutes	Count		Analysis Batch	Prep Batch	Method	Analyst Initials
		Lab Sample ID	Client Sample ID				
10/18/15 18:58	140	IC 160-223517/1		223517			PS
11/01/15 19:17	60	ICV 160-223636/1		223636			PS
09/01/16 15:17	960	ICB 160-268084/1		268084			PS
09/06/16 11:26	60	CCV 160-268361/1		268361			PS
09/15/16 09:29	1	PULSER 160-270177/1		270177			RTM
09/15/16 10:20	960	MB 160-266021/1-A		270177	266021	ST-RC-0301	RTM

## Detector: AV222

Analysis Date	Minutes	Count		Analysis Batch	Prep Batch	Method	Analyst Initials
		Lab Sample ID	Client Sample ID				
10/18/15 18:58	140	IC 160-223518/1		223518			PS
11/01/15 19:18	60	ICV 160-223637/1		223637			PS
09/02/16 10:55	960	ICB 160-268143/1		268143			PS
09/06/16 10:08	60	CCV 160-268362/1		268362			PS
09/15/16 09:29	1	PULSER 160-270178/1		270178			RTM
09/15/16 10:20	960	LCS 160-266021/2-A		270178	266021	ST-RC-0301	RTM

## Detector: AV225

Analysis Date	Minutes	Count		Analysis Batch	Prep Batch	Method	Analyst Initials
		Lab Sample ID	Client Sample ID				
10/18/15 18:59	140	IC 160-223521/1		223521			PS
11/01/15 19:18	60	ICV 160-223640/1		223640			PS
09/01/16 15:17	960	ICB 160-268087/1		268087			PS
09/06/16 10:14	60	CCV 160-268364/1		268364			PS
09/15/16 09:29	1	PULSER 160-270180/1		270180			RTM
09/15/16 10:19	960	160-18504-F-1-Q DU		270180	266021	ST-RC-0301	RTM

## Detector: AV230

Analysis Date	Minutes	Count		Analysis Batch	Prep Batch	Method	Analyst Initials
		Lab Sample ID	Client Sample ID				
10/18/15 19:00	140	IC 160-223526/1		223526			PS
11/01/15 19:19	60	ICV 160-223645/1		223645			PS
09/01/16 15:17	960	ICB 160-268092/1		268092			PS
09/06/16 10:11	60	CCV 160-268368/1		268368			PS
09/15/16 09:29	1	PULSER 160-270184/1		270184			RTM
09/15/16 10:19	960	160-18521-1	YMTFA74SE001	270184	266021	ST-RC-0301	RTM

## Detector: AV232

Analysis Date	Minutes	Count		Analysis Batch	Prep Batch	Method	Analyst Initials
		Lab Sample ID	Client Sample ID				
10/18/15 21:31	140	IC 160-223528/1		223528			PS
11/01/15 20:29	60	ICV 160-223647/1		223647			PS
09/01/16 15:17	960	ICB 160-268094/1		268094			PS
09/06/16 10:09	60	CCV 160-268370/1		268370			PS
09/15/16 09:29	1	PULSER 160-270185/1		270185			RTM
09/15/16 10:19	960	160-18521-2	YMTFA75SE001	270185	266021	ST-RC-0301	RTM

# **Shipping and Receiving Documents**

# TestAmerica St. Louis

Earth City, MO 63045  
Phone (314) 298-8566 Fax (314) 298-8757

# Chain of Custody Record

THE LEADER IN ENVIRONMENTAL TESTING

<b>Client Information</b>		Sampler: <b>R. Stouj</b>	Lab PM: Gish, Erika K	Carrier Tracking No(s): <b>8100 3192 5927</b>	COC No: 160-4416-2171.4																		
		Phone: <b>865-255-5540</b>	E-Mail: erika.gish@testamericanainc.com	FedEx	Page: 4 of 4																		
Alliant Corporation		<b>Analysis Requested</b> <input type="checkbox"/> Total Number of Contaminants <input type="checkbox"/> Preservative Codes: A - HCl      M - Hexane B - NaOH      N - None C - Zn Acetate      O - AsNaO2 D - Nitric Acid      P - Na2OAs E - NaHSO4      Q - Na2SO3 F - MeOH      R - Na2SCo3 G - Ammonium      S - H2SO4 H - Ascorbic Acid      T - TSP Dodecylhydrate I - Ice      U - Acetone J - DI Water      V - MCAA K - EDTA      W - pH 4.5 L - EDA      Z - other (specify) Other:																					
Address: 320 N Cedar Bluff Road Suite 200	City: Knoxville	Due Date Requested:	TAT Requested (days): <i>by contract</i>	Total Number of Contaminants																			
State, Zip: TN, 37923	Phone: <b>865-255-5540</b>	PO #: 16-PO-001581	Project #: <b>4324</b>																				
Email: mfrost@alliantcorp.com	WO #:	SSOW#:	Field Filled Sample Yes or No)	Field Filled Sample Yes or No)	Perform MS/MSD (Yes or No)																		
Project Name: ORNL Y-12 Outfall 200 Characterization	Site: <i>-12 Headworks/9720-8</i>																						
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Empty Kit Relinquished by: <i>R. Stouj</i>	Date: <b>8-5-2014/1400</b>	Received by: <i>Mr. S.</i>	Time: <b>080016</b>	Method of Shipment: <b>0850</b>	Date/Time: Company																		
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Custody Seals Intact: <input type="checkbox"/> Yes <input type="checkbox"/> No					Cooler Temperature(s) °C and Other Remarks:																		

## Login Sample Receipt Checklist

Client: Alliant Corporation

Job Number: 160-18521-2

SDG Number: Headworks/9720-8

**Login Number: 18521**

**List Source: TestAmerica St. Louis**

**List Number: 1**

**Creator: McKinney, Gerrod E**

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	